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Evaluation of the effect of illustrations on comprehension in the fifth and sixth grades

BOSTON UNIVERSITY

SCHOOL OF EDUCATION

AN EVALUATION OF THE EFFECT OF ILLUSTRATIONS ON COMPREHENSION IN THE FIFTH AND SIXTH GRADES

Submitted by

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Bachelor of Science in Education

State Teachers College, Worcester

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In partial fulfillment of requirements

for the degree of Master of Education

1946

First Reader: Donald D. Durrell, Professor of Education

Second Reader: Helen A. Murphy, Assistant Professor of Education

Third Reader: W. Linwood Chase, Professor of Education

ACKNOWLEDGMENTS

My sincere appreciation and thanks to Dr. Donald D. Durrell, Dean, Boston University School of Education, and to Dr. Helen A. Murphy, Assistant Professor, Boston University, for their help in planning and carrying out this study.

I wish to thank Mr. Merle A. Sturtevant, Superintendent of Schools in Shrewsbury, Massachusetts, for permitting me to carry out this experiment in his schools. Thanks are also due Mr. Cobb, Mrs. Curley, Mrs. Greany, Miss Duffy, Miss Robinson, Miss Wenz, and Mrs. Howe, teachers in whose classroom this experiment was carried out.

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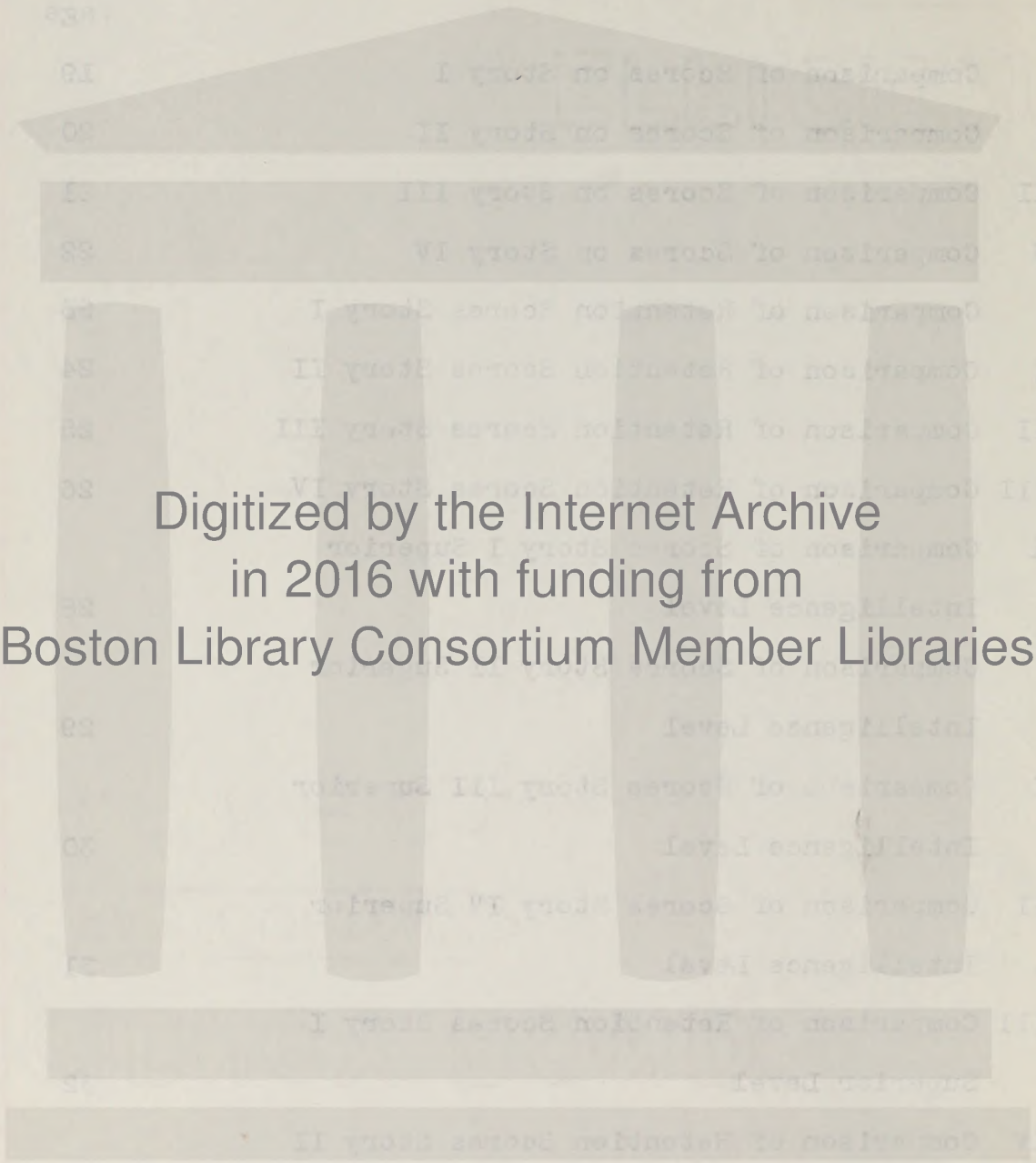

CHAPTER I

INTRODUCTION

This study is an effort to measure the effect of illustrations on the comprehension of the fifth and sixth grade children in silent reading.

Richards[1/] in a previous study undertook this same study. In her plan no effort was made to call the children's attention to the illustrations and in some cases the comprehension checks were not based on the illustrations. It seemed that these two factors might have had bearing on her findings. Therefore, the writer undertook this study using a larger population and attempting to control these variables.

1/ Claire E. Richards, "An Evaluation of the Effect of Illustrations on Comprehension in the Fifth and Sixth Grades, " Master's Thesis, Boston University, School of Education, Boston, 1945.

CHAPTER II

SUMMARY OF PREVIOUS RESEARCH

Recent years have witnessed marked changes in primary readers. One of the most striking developments has been the increased use of illustrations. In some of the more recent books the pictures comprise one of the chief features.

Some research has been directed toward the problems connected with illustrations in primary readers. Several studies have shown the types of illustrative techniques which children prefer.

Miller[1/] studied what children see in pictures when no direction or stimulation is given. He concluded that:

> "1. Children reported seeing relatively few items possible.
> 2. The items of a picture are seen in isolation rather than in parts of a whole.
> 3. The most important items in a picture often escape the notice of the children.
> 4. Children with higher intelligence quotients tend to identify more items in pictures than do children with lower intelligence quotients.
> 5. In grade three chronological age is not important for identification of items in pictures.
> 6. There are no significant sex differences in ability to identify items in pictures."

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[1] William T. Miller. "What Children See in Pictures," Elementary School Journal. 39:280-6, December, 1938.

He suggests that teachers will have to direct the child's attention to the illustrations and develop an interpretation of these items if pictures are to be an aid to understanding of printed material.

Miller[1] investigated whether children who read a basal set of primary readers with accompanying illustrations secure greater comprehension of the material read than do pupils who read the same material without pictures.

He concluded that children who read without pictures understood what they read as well as did children who read the same material with the aid of pictures.

In a previous study,[2] the same author contributes five reasons that may be responsible for the failure of pictures to aid more to the understanding of the reading material. The five factors are:

> "1. Children do not read pictures accurately.
> 2. Verbalism may exist in picture reading as well as in printed material.
> 3. Children may get only general impressions if they have had no training in reading pictures.
> 4. Some children get erroneous meanings from pictures because of limited experiences.
> 5. Pictures are not always focused on the parts of the reading matter most difficult to understand."

1/William A. Miller; "Reading With and Without Pictures," Elementary School Journal, 38:676-82, May, 1938.

2/William A. Miller, "The Picture Crutch in Reading," Elementary English Review, 14:263-64, November, 1937.

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[1] William A. Miller; "Reading With and Without Pictures," Elementary School Journal. 56:278-82, May, 1956.

[2] William A. Miller. "The Picture Question in Reading." Elementary English Review. 14:263-64, November, 1937.

In his conclusion he says,

> "It is possible that in the matter of illustration we have used adult standards in judging what we call the interests of children without distinguishing between the appeal of brightly colored pictures and the appeal of well-written story material that has intrinsic worth."

Miller[1/] reports there is no agreement on the best type of illustrative technique. The choice of illustrations is probably determined by the personal ideas of the artist, the publisher's ideas of what is suitable, and the cost of reproducing the pictures. In many books for young readers half the space is devoted to illustrations. If large proportions of the space in books are to be given over to illustrations, the cost of which appreciably conditions the price of the books, it is proper to inquire which is the most suitable illustrative technique. If illustrations are to a useful purpose they must appeal to children, and no one is so well qualified to state the preferences of children as they are themselves.

1/William A. Miller, "The Picture Choice of Primary-Grade Children," Elementary School Journal, 37:273-82, December, 1936.

Bamberger[1] studied children's preferences in illustrations and concluded that children prefer:

1. Illustrations in which the colors are bright, highly saturated and fairly intense.
2. Action and humor.
3. Illustrations that suggest stories.
4. Few details.
5. Full page pictures to pictorial insertions.
6. Median size four and one-half inches long by four inches wide.
7. Blue, red, and yellow, but especially blue.

Mellinger[2] making a study of 821 children in grades one, three, and five for the purpose of finding out whether children preferred colored or black and white illustrations and to discover whether they preferred a conventionalized style or a presentation or realistic, reports that:

1. Children have decided preferences.
2. Prefer color to black and white.
3. Prefer realistic to conventionalized styles.

Newton[3] states that a picture to an adult has the power of suggestion and associations and is reminiscent of years of seeing and living. He found that pictures have almost

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1/Florence E. Bamberger, The Effect of the Physical Make-up of a Book Upon Children's Selection, Johns Hopkins University Studies in Education, No. 4, Baltimore, Md., Johns Hopkins Press, 1922.

2/Bonnie E. Mellinger, Children's Interests In Pictures, Teachers College Contributions to Education, No. 516, New York: Teachers College, Columbia University, N.Y., 1932.

3/Lesley Newton, "Modern Trends in Book Illustrating For Children," Elementary English Review, 9:89, April, 1932.

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3/Lesley Newton, "Modern Trends in Book Illustrating For Children." Elementary English Review. 9:85. April. 1932.

purely objective interest for the child. He found also that:

"1. Story-telling quality of pictures appeals to children.
2. Trend is toward simplification.
3. Strong vivid colors are liked.
4. Humor enjoyed by children.
5. Pictures must be understandable.
6. Aesthetic qualities of line, color, and form are a matter of education and development."

Halbert[1] using three elementary school readers concluded that:

"1. The results indicate that children get more relevant ideas from reading a story with pictures than from reading the story alone or from the pictures alone."

This conclusion is true, regardless of the fact that in presenting the story with pictures, the investigator did not instruct the children to look at the pictures or to report on what they saw in the pictures.

2. The results of the story with pictures over the story without pictures seem to mount with and increase in the relevancy of the pictures when seen alone. This fact indicates that it may be possible to select pictures with a high degree of relevancy to the story.

1/Marie G. Halbert, "An Experimental Study of Children's Understanding of Instructional Materials," Bulletin of the Bureau of School Services, University of Kentucky, No. 5, 15:7-66, 1943.

purely objective interest for the child. He found also that:

"1. Story-telling quality of pictures appeals to children.
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1/ Merle O. Halbert. "An Experimental Study of Children's Understanding of Instructional Materials," Bulletin of the Bureau of School Services, University of Kentucky, No. 6, 15:7-66, 1943.

3. From the standpoint of stimulating and arousing a variety of ideas, pictures are superior to reading matter alone or to reading matter with pictures.

4. The majority of the ideas reported from pictures alone were irrelevant to the story or to the ideas intended in the pictures.

5. From the standpoint of stimulating ideas which are directed toward some specific goal, pictures alone are inferior to reading matter with or without pictures.

6. When the stimulating effect of pictures is directed by reading matter, there is an increase in the number of relevant ideas.

7. The materials used in this study are well adapted to the background and experience of the children. This fact is apparent in the comparatively small number of irrelevant ideas reported by the children."

Denault 1/ was concerned with the effect of illustration on mental imagery. She used sixty-four children in grade four. Four stories were presented in rotation, two were illustrated and two not illustrated. She found that the differences in mental imagery were not statistically significant. The investigator also discovered no difference in the amount retained.

1/Edna F. Denault, "Effect of Illustrations in Stories on the Mental Imagery of Children in Grade Four," Master's Thesis, Boston University School of Education, Boston, 1944.

According to Zisman[1] the first step in improving illustrative materials in textbooks is to improve the textbooks.

The function of the illustration should be clearly understood. To use illustrations functionally the following two principles should guide the selection and placing of illustrations:

> "1. Illustrations should be functional in subject content---illuminating or emphasizing the text or serving as an organic part of the text.
>
> 2. Illustrations should be functional in visual arrangement---providing continuity and unity in reading."

Melbo and Waterman[2] suggest that in geography it is vitally important that new understandings be developed. Pictures account for from twenty to twenty-five per cent of the content of a geography textbook. These pictures should function as teaching materials and not as ornaments for the book. Their primary purpose is to serve as visual aids which will definitely help the children to understand the

1/S.B.Zisman, "Improving Illustrative Material in Textbooks," Educational Screen, 17:218-19, September, 1938.

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adjustments that people have made to their natural environments. These authors warn us that even though a picture is highly significant geographic material in a legible and attractive manner, it may be practically worthless if it is out of date and no longer a truthful presentation of the current situation.

Goodykoontz[1] evaluated illustrations in textbooks for children in grades six through eight and reports the following values:

1. Enrichment of experiences,
2. Aids to visual imagery,
3. Contributes to the text,
4. Ensures meaningful reading,
5. Adds understanding and pleasure.

She implies that a very close relationship exists between the text and reading of pictures and offers the following illustrations in developing comprehension in reading:

"1. That pictures are accepted and used as integral parts of a book's subject matter.

2. That pictures are read as text is read, so as to supply meaning to the text which they accompany or to provide meaning which the text alone cannot supply.

1/Bess Goodykoontz, "Relation of Pictures in Reading Comprehension," Elementary English Review, 13:125-30, April, 1936.

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[1]Hess Goodykoontz, "Selection of Pictures in Reading Comprehension," Elementary English Review, 13:125-30, April, 1936.

3. That pictures encourage or motivate persons to read books or other material which they otherwise might not read."

She concluded too, that although pictures undoubtedly provide vicarious experience which adds to the understanding, further evidence is necessary in order to help authors and publishers in the selection and arrangement of pictures and to aid teachers in educating children to use pictures effectively.

MacLean[1] using colored and non-colored pictures concluded that a set of pictures for educational purposes, rather than being all colored or all uncolored should in most cases be a combination.

According to Warnock[2] in the selection of all illustrated books, one should keep in mind that they are for the use of the child and not the adult. There must be simplicity in lines so as not to be confusing. In the books for pleasure reading they should be in keeping with the spirit of the text.

1/W.P.MacLean, "A Comparison of Colored and Uncolored Pictures," Educational Screen, 9:196-99, September, 1936.

2/Lucile Warnock, "Illustration of Children's Books," Elementary English Review, 15:161-5, May, 1938.

Richards[1] study was to determine to what extent illustrations effect the reader's comprehension of factual material in the fifth and sixth grades. She discovered that:

"1. The illustrations seemed to have little effect on the comprehension scores. In three out of the four stories, the differences noted were in favor of the illustrated material. In one story the difference was in favor of the non-illustrated material. None of the differences were statistically significant.

2. The results of the retention scores were not consistent. Stories one and two were in favor of the non-illustrated material and three and four were in favor of the illustrated. The difference in Story One was statistically significant.

3. The children with Superior Intelligence had higher scores on the non-illustrated material in three out of the four stories. In one case, Story Three, the difference was significant.

4. In two stories, the retention is better in illustrated material and in two stories the non-illustrated scores were higher. None of the scores was significant.

5. The children with average Intelligence Quotients had slightly higher socres in the illustrated material than in the non-illustrated material in three of the four stories. None of the differences was significant.

1/Claire E. Richards, "An Evaluation of The Effect of Illustrations On Comprehension In the Fifty and Sixth Grades," Master's Thesis, Boston University, School of Education, Boston, 1945.

6. The retention scores for the average group were slightly higher in the illustrated material in three of the four stories. None of the differences was significant."

The author concluded that several limitations were in evidence:

"1. The type of illustrations used had definite limitations.

2. They did not meet the standards found by experimentation to be preferred by children, being non-professional pen and ink line drawings.

3. It is doubtful if interest was created or attention sustained by the type of illustration used.

4. It was felt by the writer that illustrations were not meaningful in all instances."

The writer, using Richards[1/] stories and illustrations with a larger population, undertook in her study to call children's attention to the illustrations and based comprehension and recall checks wholly on the illustrations. This was to discover if these factors have any bearing in determining to what extent illustrations effect the comprehension of factual material read by fifth and sixth grade pupils.

1/ Richards, op. cit., p. 43-45.

CHAPTER III

PLAN OF THE EXPERIMENT

Illustrations add interest and enjoyment to reading. The writer wants to find out to what extent illustrations affect the understanding of written material. Every year a great deal of money is spent illustrating textbooks; it is important for the publishers to know if these illustrations are serving their purpose. It is the purpose of this experiment to find out to what extent illustrations affect the understanding of material read.

In setting up this study, it was necessary:

1. To decide upon the best way to secure the desired information.

2. To decide the population to be used.

3. To secure the cooperation of a school or schools where the study could be carried out.

The writer decided to use the same selections and illustrations as Richards.[1] A story about the Panama Canal, from Our Country by Beebe, Hanna, McClure published by

1/ Claire E. Richards, "An Evaluation of the Effect of Illustrations on Comprehension in the Fifth and Sixth Grades," Master's Thesis, Boston University, School of Education, Boston, 1945, 18 pp.

Laidlaw and Company. The second story included in each booklet was entitled "The Weatherman and His Work." This story was taken from the Unit Study Book No. 551, Weather, by A. Eleanor Thomas. The third story, about the Sequoia trees of California, was taken from Stories In Trees written by Mary I. Curtis and published by Lyons and Carnahan. This story is called "A Giant Forest." The fourth and last story was an original story by Claire E. Richards. It was given the title "Sailing." Each story was concerned with a different area in the social studies field and an attempt was made to select topics which would be of interest to the children as well as unfamiliar to them.

Four stories were united in booklet form. Two forms of the booklet were prepared, Form A and Form B. Each of the four stories was presented in two forms, one with illustrations, the other without illustrations. The same stories were used in both booklets.[1/]

A plan of rotation was arranged in order to equate the stories for difficulty. The stories were incorporated in two booklets called Form A and Form B of the experiment.

1/ See Appendix

In Form A, the first story, "The Panama Canal," and the third story, "A Giant Forest," were illustrated while the second story, "The Weatherman and His Work," and the fourth story, "Sailing," were not illustrated. In Form B the first story, "The Panama Canal," and the third story, "A Giant Forest," were not illustrated while the second story, "The Weatherman and His Work," and the fourth story, "Sailing," were illustrated.

The illustrations were black and white line drawings done by Richards.

Directly following each story read was a comprehension check.[1/] The comprehension check consisted of multiple choice questions. All questions were based on the illustrations.

Most all of the studies pertaining to this phase of reading were carried out in the lower grades. This study was carried out in the fifth and sixth grades of the town of Shrewsbury, Massachusetts. There were three fifth grades and four sixth grades in three different buildings which was the total population of the town's fifth and sixth graders. All were included in the study. No one was excluded because of reading difficulties or for any other

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The illustrations were black and white line drawings done by Hoberts.

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[1] See Appendix

reason, except not being present for retention check-up. It was a heterogeneous group not a selected population.

This study required two weeks. The first day the booklets were distributed to the pupils in alternation, one child receiving Form A of the booklet, the next child Form B, etc. in this manner until each child had a booklet. Instructions were given to pupils before starting their reading. It was explained that the booklets consisted of four stories each having questions after them. The first two stories were read the first day and the questions following were answered. Attention was called to the illustrations and pupils were told to study them carefully as they would help them answer the questions. No time limit was set.

On the second day of this study booklets were passed out. Being sure pupils received the same Form as previous day. The next two stories were read and the questions following were answered. Booklets were collected. Two weeks later analogous[1/] comprehension checks which were given in the booklet were used for the retention check. Pupils were instructed to be sure and place the correct letter

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Booklets were given to 227 pupils on the first and second day of the study. Due to absences on the day of the retention check, the total number of pupils was 209. All booklets and retention checks were scored by the writer.

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Booklets were given to 229 pupils on the first and second day of the study. Due to absences on the day of the retention check, the total number of pupils was 209. All booklets and retention checks were scored by the writer.

CHAPTER IV

ANALYSIS OF DATA

The data was analyzed to study the effect of illustrations on comprehension in factual material in the fifth and sixth grades on:

1. The comprehension and retention scores of the total population.

2. The comprehension and retention scores for different intelligence levels.

A. COMPARISON OF SCORES ON TOTAL POPULATION

1. Original comprehension scores

TABLE I shows the comparison of Story I illustrated and non-illustrated.

TABLE I

Comparison of Scores on Story I

Group	Number	Mean	S.D.	S.E. M.	Diff. M.	S.E. Diff.	Critical Ratio
Illus.	114	6.41	2.19	.205	1.14	.265	4.30
Non-Illus.	113	5.27	1.80	.169			

The mean score of the illustrated stories is 6.41 compared to 5.27 for the non-illustrated stories. The critical ratio of 4.30 shows this difference to be statistically significant. The difference is in favor of the illustrated.

TABLE II shows the comparison of Story II illustrated and non-illustrated.

TABLE II

Comparison of Scores on Story II

Group	Number	Mean	S.D.	S.E. M.	Diff. M.	S.E. Diff.	Critical Ratio
Illus.	113	5.58	1.90	.179	.30	.237	1.27
Non-Illus.	114	5.28	1.80	.169			

The mean score of the illustrated is 5.58 as compared to 5.28 for the non-illustrated. The critical ratio of 1.27 indicated no significant difference. The chances are 89 in 100 that this is a true difference in favor of the illustrated.

TABLE II shows the comparison of Story II illustrated and non-illustrated.

TABLE II

Comparison of Scores on Story II

Group	Number	Mean	S.D.	S.E.	Diff. M.	S.E. Diff. M.	Critical Ratio
Illus.	115	8.58	1.30	.121			
Non-Illus.	114	8.28	1.30	.109	.30	.227	1.27

The mean score of the illustrated is 8.58 as compared to 8.28 for the non-illustrated. The critical ratio of 1.27 indicated no significant difference. The chances are 99 in 100 that there is a true difference in favor of the illustrated.

TABLE III shows the comparison of Story III illustrated and non-illustrated.

TABLE III

Comparison of Scores on Story III

Group	Number	Mean	S.D.	S.E. M.	Diff. M.	S.E. Diff.	Critical Ratio
Illus.	114	7.46	1.61	.151	.59	.22	2.68
Non-Illus.	113	6.87	1.65	.155			

The mean score of the illustrated is 7.46 as compared to 6.87 for the non-illustrated. The critical ratio of 2.68 indicated no significant difference. The chances are 99.7 in 100 that this is a true difference in favor of the illustrated.

TABLE IV shows the comparison of Story IV illustrated and non-illustrated.

TABLE IV

Comparison of Scores on Story IV

Group	Number	Mean	S.D.	S.E. M.	Diff. M.	S.E. Diff.	Critical Ratio
Illus.	113	6.92	2.13	.200	.28	.27	1.04
Non-Illus.	114	6.64	1.91	.179			

The mean score of the illustrated is 6.92 as compared to 6.64 for the non-illustrated. The critical ratio of 1.04 indicated no significant difference. The chances are 85 in 100 that this is a true difference in favor of the illustrated.

2. Comparison of Retention Scores

TABLE V shows the comparison of retention in Story I illustrated and non-illustrated.

TABLE V

Comparison of Retention Scores Story I

Group	Number	Mean	S.D.	S.E. M.	Diff. M.	S.E. Diff.	Critical Ratio
Illus.	108	5.61	1.97	.190	0	.26	
Non-Illus.	101	5.61	1.86	.185			

The mean score of both groups is identical

TABLE VI shows the comparison of retention in Story II illustrated and non-illustrated.

TABLE VI

Comparison of Retention Scores Story II

Group	Number	Mean	S.D.	S.E. M.	Diff. M.	S.E. Diff.	Critical Ratio
Illus.	101	4.93	1.70	.169	.02	.24	.08
Non-Illus.	108	4.91	1.77	.170			

The mean score of the illustrated is 4.93 as compared to 4.91 for the non-illustrated. The critical ratio of .08 indicated no significant difference. The chances are 54 in 100 that this is a true difference in favor of the non-illustrated.

TABLE VII shows the comparison of retention in Story III illustrated and non-illustrated.

TABLE VII

Comparison of Retention Scores Story III

Group	Number	Mean	S.D.	S.E. M.	Diff. M.	S.E. Diff.	Critical Ratio
Illus.	108	6.23	1.75	.168	.44	.25	1.76
Non-Illus.	101	5.79	1.80	.179			

The mean score of the illustrated is 6.23 compared to 5.79 for the non-illustrated. The critical ratio of 1.76 showed no significant difference. Chances are 96 in 100 that this is a true difference in favor of the illustrated.

TABLE VIII shows the comparison of retention in Story IV illustrated and non-illustrated.

TABLE VIII

Comparison of Retention Scores Story IV

Group	Number	Mean	S.D.	S.E. M.	Diff. M.	S.E. Diff.	Critical Ratio
Illus.	101	6.32	2.00	.199	.40	.27	1.48
Non-Illus.	108	5.92	1.92	.185			

The mean score of the illustrated is 6.32 compared to 5.92 for the non-illustrated. The critical ratio of 1.48 showed no significant difference. Chances are 93 in 100 that this is a true difference in favor of the illustrated.

B. COMPARISON OF MATERIAL ACCORDING TO INTELLIGENCE LEVELS

The population was divided according to intelligence levels into two groups. Children with intelligence quotients above 110 were considered in the superior group. The range was from 110 to 134. Those with intelligence quotients from 90 to 110 were considered in the average group. Those with intelligence quotients below 90 were not considered as there were only twenty of these. All intelligence quotients were obtained from records available at the schools where the experiment was carried out. 1/

1/ The Pintner General Ability Test, Form A

1. Comprehension Superior Group

TABLE IX shows the comparison of illustrated and non-illustrated stories at the superior intelligence level in Story I

TABLE IX

Comparison of Scores Story I Superior Intelligence Level

Group	Number	Mean	S.D.	S.E. M.	Diff. M.	S.E. Diff.	Critical Ratio
Illus.	44	7.43	1.62	.244	1.46	.38	3.38
Non-Illus.	34	5.97	1.74	.300			

The mean score of the illustrated is 7.43 compared to 5.97 for the non-illustrated. The critical ratio of 3.38 shows this difference to be statistically significant. The difference is in favor of the illustrated.

TABLE X shows the comparison of illustrated and non-illustrated stories at the superior intelligence level in Story II.

TABLE X

Comparison of Scores Story II Superior Intelligence Level

Group	Number	Mean	S.D.	S.E. M.	Diff. M.	S.E. Diff.	Critical Ratio
Illus.	34	6.29	1.48	.254	.09	.36	.25
Non. Illus.	44	6.20	1.75	.264			

The mean score of the illustrated is 6.29 compared to 6.20 for the non-illustrated. The critical ratio of .25 showed no significant difference. Chances are 60 in 100 that this is a true difference in favor of the illustrated.

TABLE XI shows the comparison of illustrated and non-illustrated stories at the superior intelligence

TABLE XI

Comparison of Scores Story III Superior Intelligence Level

Group	Number	Mean	S.D.	S.E. M.	Diff. M.	S.E. Diff.	Critical Ratio
Illus.	44	7.91	1.05	.054	.47	.25	1.84
Non-Illus.	34	7.44	1.16	.100			

The mean score of the illustrated is 7.91 compared to 7.44 for the non-illustrated. The critical ratio of 1.84 showed no significant difference. Chances are 96 in 100 that this is a true difference in favor of the illustrated.

TABLE XI shows the comparison of illustrated and non-illustrated stories at the superior intelligence

TABLE XI

Comparison of Scores Story III Superior Intelligence

Level

Group	Number	Mean	S.D.	S.E.	Diff.	C.R.	Critical Ratio
Illus.	44	7.91	1.05	.084			
Non-Illus.	84	7.44	1.18	.100	.47	.85	1.84

The mean score of the illustrated is 7.91 compared to 7.44 for the non-illustrated. The critical ratio of 1.84 showed no significant difference. Chances are 95 in 100 that this is a true difference in favor of the illustrated.

TABLE XII shows the comparison of illustrated and non-illustrated stories at the superior intelligence level in Story IV

TABLE XII

Comparison of Scores Story IV Superior Intelligence Level

Group	Number	Mean	S.D.	S.E. M.	Diff. M.	S.E. Diff.	Critical Ratio
Illus.	34	7.65	1.82	.312	.17	.43	.40
Non-Illus.	44	7.82	1.95	.294			

The mean score of the illustrated is 7.65 compared to 7.82 for the non-illustrated. The critical ratio of .40 showed no significant difference. Chances are 65 in 100 that this is a true difference in favor of the non-illustrated.

2. Retention Superior Group

TABLE XIII shows the comparison of retention scores of Story I illustrated and non-illustrated at the superior intelligence level.

TABLE XIII

Comparison of Retention Scores Story I Superior Level

Group	Number	Mean	S.D.	S.E. M.	Diff. M.	S.E. Diff.	Critical Ratio
Illus.	41	6.56	1.66	.260	1.53	.38	4.02
Non-Illus.	31	5.03	1.55	.279			

The mean score of the illustrated is 6.56 compared to 5.03 for the non-illustrated. The critical ratio of 4.02 shows a statistically significant difference in favor of the illustrated.

2. Rebellion Superior Group

TABLE XLII shows the comparison of rebellion scores of Story I illustrated and non-illustrated at the superior intelligence level.

TABLE XLII

Comparison of Rebellion Scores Story I Superior Level

Group	Number	Mean	S.D.	S.E.M.	Diff. M.	S.E. Diff.	Critical Ratio
Illus.	41	6.56	1.86	.290	1.63	.39	4.03
Non-Illus.	31	5.03	1.56	.279			

The mean score of the illustrated is 6.56 compared to 5.03 for the non-illustrated. The critical ratio of 4.03 shows a statistically significant difference in favor of the illustrated.

TABLE XIV shows the comparison of retention scores of Story II illustrated and non-illustrated at the superior level.

TABLE XIV

Comparison of Retention Scores Story II Superior Level

Group	Number	Mean	S.D.	S.E. M.	Diff. M.	S.E. Diff.	Critical Ratio
Illus.	31	6.00	1.72	.309	.71	.38	1.86
Non-Illus.	41	5.29	1.50	.234			

The mean score of the illustrated is 6.00 compared to 5.29 for the non-illustrated. The critical ratio of 1.86 shows the difference not to be statistically significant. Chances are 97 in 100 that this is a true difference in favor of the illustrated.

TABLE XV shows the comparison of retention scores of Story III illustrated and non-illustrated at the superior level.

TABLE XV

Comparison of Retention Scores Story III Superior Level

Group	Number	Mean	S.D.	S.E. M.	Diff. M.	S.E. Diff.	Critical Ratio
Illus.	41	6.95	1.49	.23	.40	.33	1.21
Non-Illus.	31	6.55	1.36	.24			

The mean score of the illustrated is 6.95 compared to 6.55 for the non-illustrated. The critical ratio of 1.21 shows the difference not to be statistically significant. Chances are 88 in 100 that this is a true difference in favor of the illustrated.

TABLE XVI shows the comparison of retention scores of Story IV illustrated and non-illustrated at the superior level.

TABLE XVI

Comparison of Retention Scores Story IV Superior Level

Group	Number	Mean	S.D.	S.E. M.	Diff. M.	S.E. Diff.	Critical Ratio
Illus.	31	6.74	1.83	.33	.18	.42	.43
Non-Illus.	41	6.56	1.76	.28			

The mean score of the illustrated is 6.74 compared to 6.56 for the non-illustrated. The critical ratio of .43 shows the difference not to be statistically significant. Chances are 67 in 100 that this is a true difference in favor of the illustrated.

3. Comprehension Average Group

TABLE XVII shows the comparison of scores of Story I illustrated and non-illustrated, average intelligence level.

TABLE XVII

Comparison of Scores Story I Average Intelligence Level

Group	Number	Mean	S.D.	S.E. M.	Diff. M.	S.E. Diff.	Critical Ratio
Illus.	63	6.02	2.25	.28	1.08	.38	2.84
Non-Illus.	68	4.94	1.72	.21			

The mean score of the illustrated is 6.02 compared to 4.94 of the non-illustrated. The critical ratio of 2.84 shows the difference not to be statistically significant. Chances are 99.74 in 100 that this is a true difference in favor of the illustrated.

TABLE XVIII shows the comparison of scores of Story II illustrated and non-illustrated at the average intelligence level.

TABLE XVIII

Comparison of Scores Story II Average Intelligence Level

Group	Number	Mean	S.D.	S.E. M.	Diff. M.	S.E. Diff.	Critical Ratio
Illus.	68	5.04	1.51	.18	.18	.29	.62
Non-Illus.	63	5.22	1.88	.24			

The mean score of the illustrated is 5.04 compared to 5.22 for the non-illustrated. The critical ratio of .62 shows the difference not to be statistically significant. The chances are 73 in 100 that this is a true difference in favor of the non-illustrated.

TABLE XIX shows the comparison of scores of Story III illustrated and non-illustrated at the average intelligence level.

TABLE XIX

Comparison of Scores Story III Average Intelligence Level

Group	Number	Mean	S.D.	S.E. M.	Diff. M.	S.E. Diff.	Critical Ratio
Illus.	63	7.11	1.47	.19	.65	.28	2.32
Non-Illus.	68	6.46	1.84	.22			

The mean score of the illustrated is 7.11 compared to 6.46 for the non-illustrated. The critical ratio of 2.32 shows the difference not to be statistically significant. The chances are 98.9 in 100 that this is a true difference in favor of the illustrated.

TABLE XX shows the comparison of scores of Story IV illustrated and non-illustrated at the average intelligence level.

TABLE XX

Comparison of Scores Story IV Average Intelligence Level

Group	Number	Mean	S.D.	S.E. M.	Diff. M.	S.E. Diff.	Critical Ratio
Illus.	68	6.04	1.85	.22	.59	.34	1.44
Non-Illus.	63	6.63	2.02	.25			

The mean score of the illustrated is 6.04 compared to 6.63 for the non-illustrated. The critical ratio of 1.44 shows no significant difference. Chances are 93 in 100 that this is a true difference in favor of the non-illustrated.

4. Retention Average Group

TABLE XXI shows the comparison of scores of Story I illustrated and non-illustrated at the average intelligence level.

TABLE XXI

Comparison of Retention Scores Story I Average Level

Group	Number	Mean	S.D.	S.E. M.	Diff. M.	S.E. Diff.	Critical Ratio
Illus.	59	4.95	1.94	.25	.44	.34	1.42
Non.Illus.	63	4.51	1.91	.24			

The mean score of the illustrated is 4.95 compared to 4.51 for the non-illustrated. The critical ratio of 1.42 shows the difference not to be statistically significant. Chances are 92 in 100 that this is a true difference in favor of the illustrated.

TABLE XXII shows the comparison of retention scores of Story II illustrated and non-illustrated at the average level.

TABLE XXII

Comparison of Retention Scores Story II Average Level

Group	Number	Mean	S.D.	S.E. M.	Diff. M.	S.E. Diff.	Critical Ratio
Illus.	63	4.65	1.72	.22	.14	.30	.47
Non-Illus.	59	4.51	1.64	.21			

The mean score of the illustratedis 4.65 compared to 4.51 for the non-illustrated. The critical ratio of .47 shows the difference not to be statistically significant. Chances are 67 in 100 that this is a true difference in favor of the illustrated.

TABLE XXIII shows the comparison of retention scores of Story III illustrated and non-illustrated at the average intelligence level.

TABLE XXIII

Comparison of Retention Scores Story III Average Level

Group	Number	Mean	S.D.	S.E. M.	Diff. M.	S.E. Diff.	Critical Ratio
Illus.	59	5.93	1.53	.20	.41	.30	1.37
Non-Illus.	63	5.52	1.87	.24			

The mean score of the illustrated is 5.93 compared to 5.52 for the non-illustrated. The critical ratio of 1.37 shows no significant difference. The chances are 91 in 100 that this is a true difference in favor of the illustrated.

TABLE XXIV shows the comparison of retention scores of Story IV illustrated and non-illustrated at the average level.

TABLE XXIV

Comparison of Retention Scores Story IV Average Level

Group	Number	Mean	S.D.	S.E. M.	Diff. M.	S.E. Diff.	Critical Ratio
Illus.	63	6.22	1.92	.24	.86	.34	2.53
Non-Illus.	59	5.36	1.84	.24			

The mean score of the illustrated is 6.22 compared to 5.36 for the non-illustrated. The critical ratio of 2.53 shows the difference not to be statistically significant. Chances are 99.4 in 100 that this is a true difference in favor of the illustrated.

CHAPTER V

SUMMARY AND CONCLUSIONS

The purpose of this study was to determine the effect of illustrations in factual material on the reader's comprehension in the fifth and sixth grade levels.

To carry out this experiment, four stories were incorporated into booklet form. Two forms of the experiment were constructed. In one form (Form A) the first and third stories were illustrated and the second and fourth stories were not illustrated. In the other form of the experiment (Form B) the first and the third stories were not illustrated and the second and the fourth stories were illustrated. The same stories were included in both forms of the experiment.

The stories were presented to a heterogeneous population in three fifth grades and in four sixth grades in the same town. The experiment was carried out on the total population of 227 pupils.

Richards[1] carried out a similar experiment but did not call attention to the illustrations or build her comprehension checks and re-checks on the illustrated material.

1/ Richards, op. cit., p. 43-45

In carrying out this experiment the children's attention was called to the illustrations. The comprehension checks and re-checks were based on material included in the illustrations.

Limitations are still in evidence. The illustrations being non-professional pen and ink line drawings, they may not have met the standards found by experimentation to be preferred by children. In some cases the illustrations were too complicated and their significance was lost by the children.

CONCLUSIONS

A. Comparison of comprehension scores of total population.

1. The illustrations seemed to have great effect on the comprehension scores. In all four stories the differences was in favor of the illustrated group.
   In Story I the difference was statistically significant.
2. The results of the retention scores were all in favor of the illustrated with the exception of Story I. In Story I the mean score of both groups was identical. None of the differences was statistically significant.

B. Comparison of Comprehension scores by Intelligence Levels.

1. The children with superior intelligence had higher scores on all the illustrated material. In one case, Story I, the difference was significant.
2. In three stories, the retention is better in illustrated material, and in one story the non-illustrated score was higher. None of the scores was significant.

C. Comparison of Comprehension scores by Average Levels.

1. The children with average intelligence quotients had two stories favoring illustrated and two favoring non-illustrated stories. One and three were in favor of the non-illustrated and two and four were in favor of the illustrated. None of the differences was statistically significant.
2. The retention scores for the average group in all four stories were all in favor of the illustrated material. None of the differences was significant.

CHAPTER VI

SUGGESTIONS FOR FURTHER RESEARCH

Throughout this study the following topics came to my attention as possibilities for further research.

1. Repetition of this experiment using a larger population.

2. Experiment with several kinds of illustrations.

3. Repeat this experiment at different grade levels.

4. Set up a like experiment using original stories and illustrations based on locality.

5. Check retention at later times.

6. Experiment based on sex differences using intelligence as a median of division.

APPENDIX

FORM A

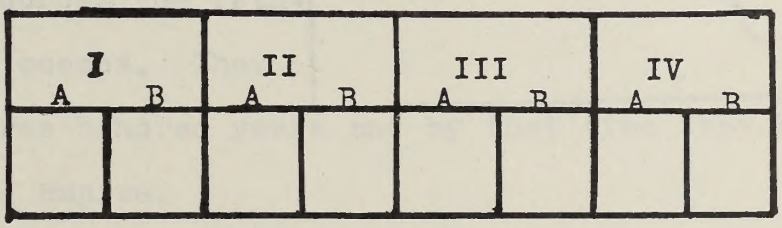
NAME:

GRADE:

SCHOOL:

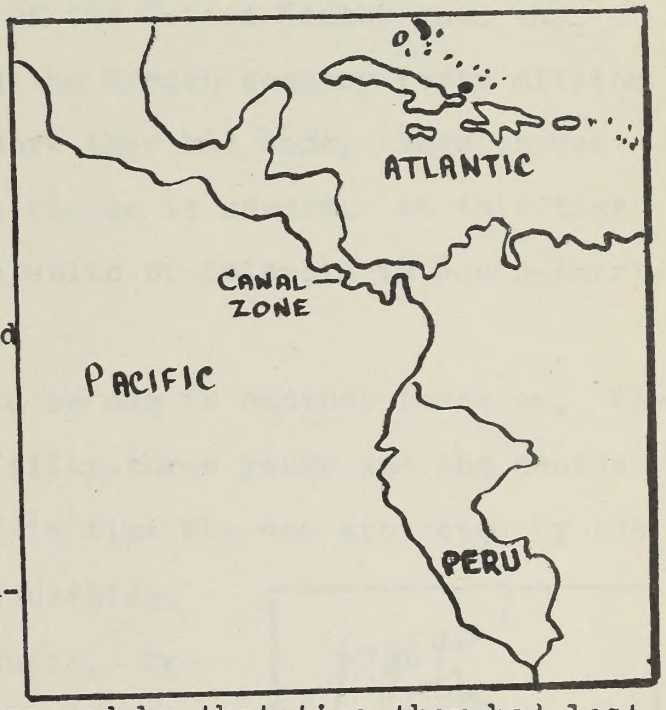
DATE OF BIRTH:

DATE TODAY:



The Panama Canal

You have learned how Columbus sailed westward across the Atlantic Ocean in search of a short route to the Spice Islands of the East. Columbus died without knowing that he had discovered two large continents and that these continents barred his short route to the East. The great discoverer sailed along the Isthmus of Panama looking for a passageway. Other explorers kept up the search for two hundred years before they learned that the New World blocked their westward route all the way from a frozen ocean in the north to another frozen ocean in the south. You have read how Balboa crossed the Isthmus of Panama and discovered the Pacific Ocean and heard stories of vast wealth in the lands farther south.

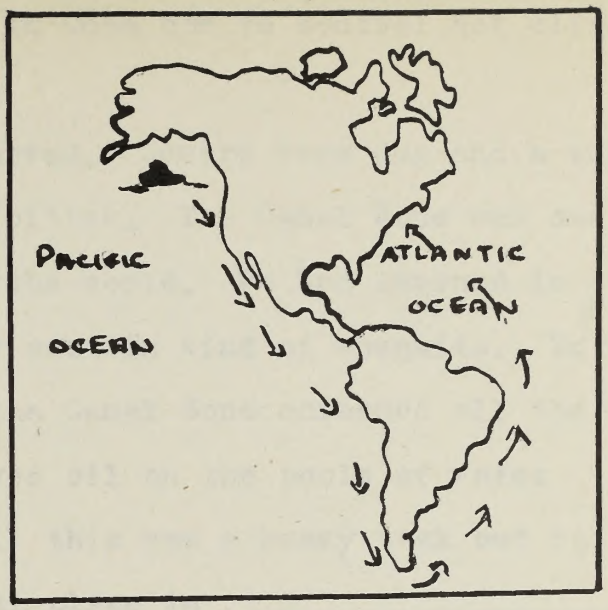


This wealth was soon discovered. Then there was a great deal of travel across the isthmus to get the gold and silver of Peru and ship it to Spain. Only thirty years after the discovery of America, the Spanish began to talk about digging a canal across the isthmus to connect the two oceans. They talked about it for three hundred years and by that time they had lost most of their New World empire.

Nothing was done until about sixty uears ago, when a French company made an attempt to dig the canal. The work was badly managed and there was much sickness among the workers. In a few years the company could raise no more money and the work stopped.

Reprinted from Our Country Beebe-Hanna-McClure, Laidlaw.

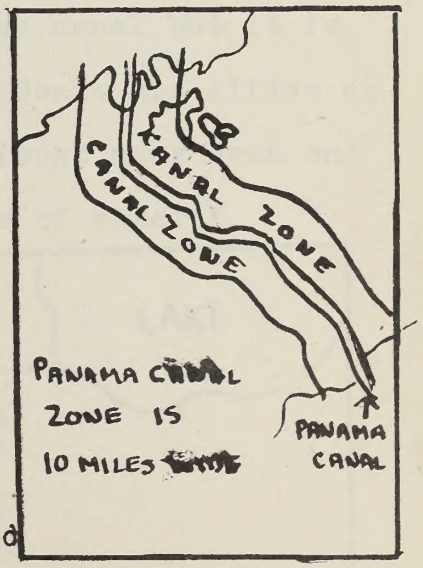
The United States had been deeply interested in a canal across the isthmus for many years. A canal would shorten immensely the sailing distance between our east and west coasts. The value of a canal was clearly shown in the war with Spain when one of our battleships had to steam all the way around South America to go from the Oacific Ocean to the Atlantic.



Theodore Roosevelt was President of the United States when the work was started. Our government paid the French company forty million dollars for their rights and for the work they had done. This payment did not give the United States all the rights it needed. At this time Panama was one of the states of the Republic of Colombia in South America.

Panama feared that the canal would be dug in another location. She had fought fifty-three revolutions in fifty-three years and she decided it was a good time to have another. This time she was protected by the United States and so Colombia could do nothing.

Panama became an independent republic. Two weeks later she sold the Canal Zone to the United States for ten million dollars. The United States also promised to pay Panama $250,000 each year. The Canal Zone is a strip of land ten miles wide reaching from ocean to ocean.

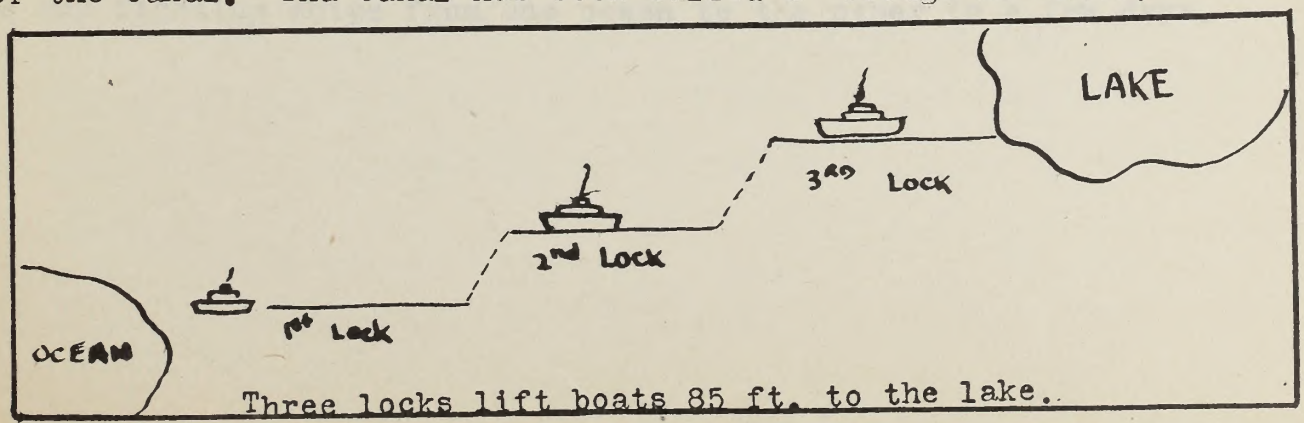


Before the United States could start the real work on the canal, the Canal Zone had to be cleaned up and made free from yellow fever and malaria. This work was in charge

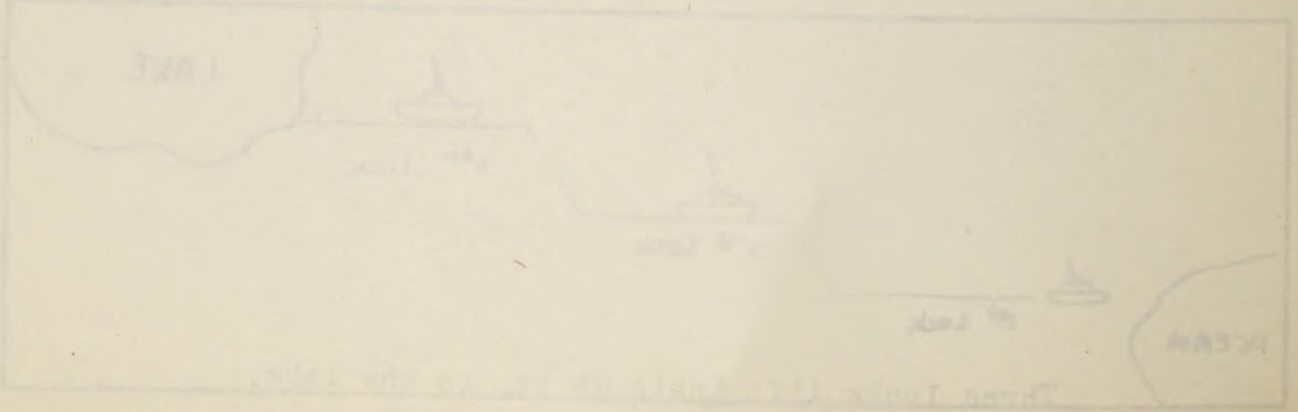
of William C. Gorgas who had learned in Cuba how to control hot climate diseases.

The streets of the cities were paved. Sewers were dug and a supply of pure water was piped into the cities. The Canal Zone was one of the worst yellow fever regions in the world. We had learned in Cuba that yellow fever is spread by a certain kind of mosquito. To fight this insect the government of the Canal Zone screened all the houses, drained the swamps, and sprayed oil on the pools of water where mosquitoes laid their eggs. All this was a heavy task but it made the Canal Zone the most healthful place in the hot regions of the world. After trying several other engineers, the government placed the work of digging the canal in charge of George W. Goethals of the United States Army.

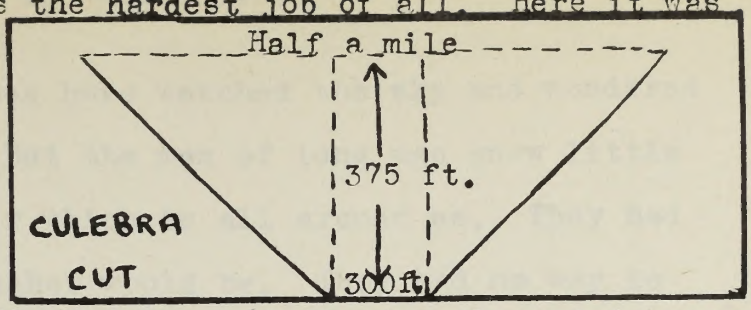
The Atlantic end of the Canal Zone has more than twelve feet of rain a year. This amount of rain makes the streams full and swift. They tumble down the hills and rush on to the ocean. The American engineers built an immense dam across one of the rivers and in this way made a large body of water which is now a huge lake. This lake makes up twenty-three miles of the canal but it is eighty-five feet above the level of the oceans. Boats are lifted up to the level of the lake by means of three large locks near each end of the canal. Tha canal has been called a "bridge of water."

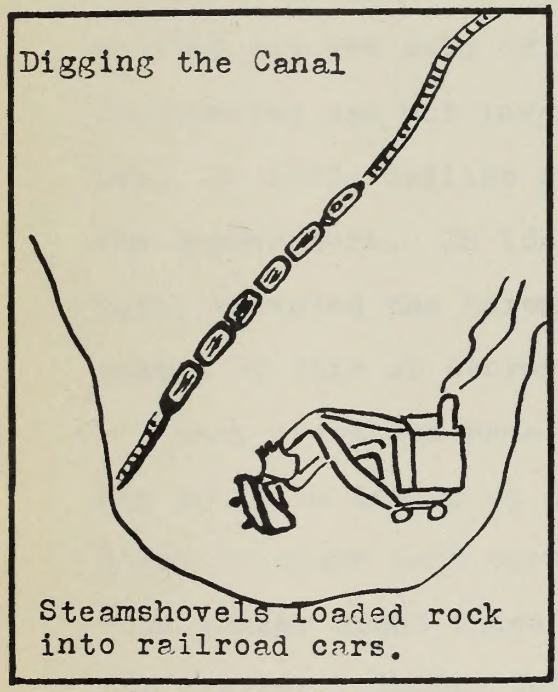


Three locks lift boats 85 ft. to the lake.



Digging the Culebra Cut was the hardest job of all. Here it was necessary to dig through nine miles of almost solid rock. This great ditch is three hundred seventy-five feet deep and three hundred feet wide at the bottom. At the top the cut is more than a half a mile wide.

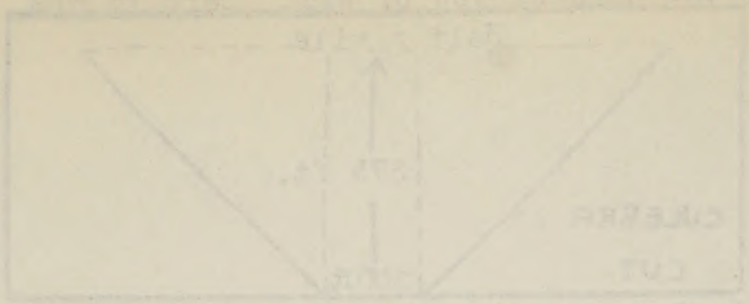




Steamshovels loaded rock into railroad cars.

The Panama Canal was a machine age undertaking. Large steam shovels loaded the rock and earth into railroad cars. The long trains were pulled away by locomotives and the rock and dirt taken off by machinery. The great work was finished in the year when the First World War began. It was now clearer than ever before that the United States was becoming a world power with world-wide interests to protect.

The Panama Canal is now one of the busiest trade routes in the world. In peace times it is used on equal terms by the ships of all nations. The canal has shortened the sailing distance between our eastern and our western coasts by ten thousand miles. It has brought the seaports of western South America seven thousand miles nearer to our eastern seaports than they were before. In time of war we can move our fighting ships from one ocean to the other in a few days.



The Weatherman and His Work

For hundreds of years men have watched the sky and wondered about tomorrow's weather. But the men of long ago knew little about the great ocean of air which is all around us. They had no way to tell what the weather would be. They had no way to send news of the weather quickly from place to place.

When Columbus discovered America, no way had been invented to find out how cold or how hot the weather was. The first thermometer was not invented until about one hundred years later. In 1593, Galileo of Italy made a crude instrument to mark the temperature. In 1643, Torricelli, his assitant and secretary, invented the barometer, or weather-glass, which marks the coming of fair or stormy weather.

Many great men have been interested in the weather. Benjamin Franklin looked up at the sky just as you and I do and wondered if those dark clouds meant rain. In fact, he did more than wonder about those clouds. Franklin studied the winds and the weather. Thomas Jefferson was interested in the weather, too. He actually owned a barometer, and in those days there were only two in all the Colonies.

Real weather forecasting in our country did not begin until the year 1870. By that time, the American Colonies had become the United States of America. The early pioneers had crossed the continent in their covered wagons and settled the West. Trains puffed and snorted over the plains and through the mountains. Telegraph wires linked the Pacific Coast and the Atlantic Coast. News could now be carried quickly from place to place.

Reprinted from Weather by A. Eleanor Thomas, Unit Study Book, No. 551.

Congress gave the Secretary of War the duty of setting up weather stations and sending out weather reports. He was to collect news of the weather from all parts of our country and from this news forecast the weather. Twenty years later, in 1890, the United States Weather Bureau was set up as part of the Department of Agriculture in Washington, D.C.

Uncle Sam is now in touch with hundreds of weather stations. Most of these are in the United States, but there are also some in Canada, Alaska, Hawaii, Mexico, the Canal Zone, the West Indies, Europe and Asia.

Every morning and every evening at eight o'clock, weathermen at observing stations study the clouds and look at their instruments. The barometers tell them the pressure or weight of the air. The thermometers tell them the temperature of the air. The anemometer tells them the force and speed or velocity of the wind, and the weather vane tells them which way the wind is blowing. The hygrometer tells them how much moisture is in the air. Special gauges show how much snow or rain has fallen. Sunshine recorders, barographs, and thermographs trace a record of the changes in the weather. Every morning, too, these weathermen study the height of the clouds, or the ceiling limits, and figure out the dew points.

At the same time, pilots at 26 airports in all parts of our country hop into their planes and take off. These pilots are going up to study the weather from high in the sky. The weather instruments in the cockpit of each plane will tell them the air pressure, temperature and humidity at different heights.

At about 60 weather stations, men fill small balloons with hydrogen and send them into the upper air. These weather balloons help measure the speed and direction of the wind and the height of the ceiling. The balloons are sent up at least four

times within every 24 hours and oftener if the weather is very stormy or a bit unusual.

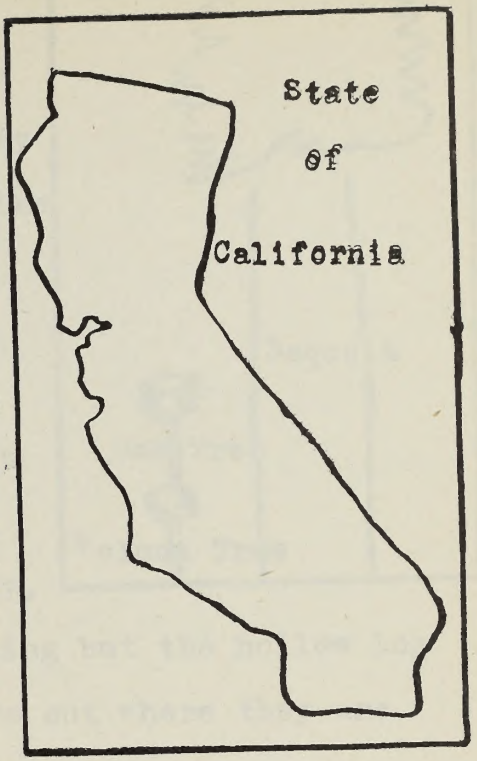
News of the weather is sent from the weather stations to the big United States Weather Bureau in Washington, D.C. The telegraph wires buzz and hum. The radio clicks busily. Weather stations in Alaska, Canada, Hawaii, the West Indies, the Canal Zone and Mexico are sending in reports.

The pilots of airplanes and the captains of ships at sea flash their weather reports to Washington. More weather news comes from other countries across the Atlantic and across the Pacific, from the Azores, Iceland, Greenland and the Faroe Islands.

From all these reports, weather maps are made and studied by weather experts in Washington, D.C., Chicago, New Orleans, Denver and San Francisco. They learn about coming frosts, cold waves, blizzards, hot spells, hurricanes, storms, floods, and the weather in general. Then the weather experts prepare their forecasts.

Within two hours after the weather reports have been flashed from faraway corners of the world, the forecasts are being sent out by telegraph to nearly two thousand stations in different parts of our country. From there, the forecasts are spread still further by telegraph, telephone, radio, newspapers, and even by mail.

A Giant Forest



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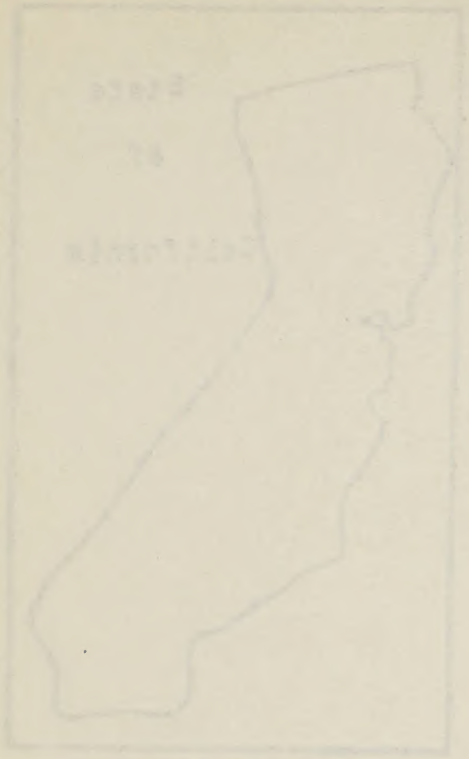
We usually call these giant trees the Big Trees of California, but if a botanist were speaking of one of them he would call it by its name, Sequoia. The Big Trees were named in honor of the famous Cherokee Indian Chief, Sequoia, who was the wisest man of his tribe and a very great man among the Indians, because he invented an alphabet for the language of his people so that they could learn to read and write, instead of making signs and pictures as they had always done before.

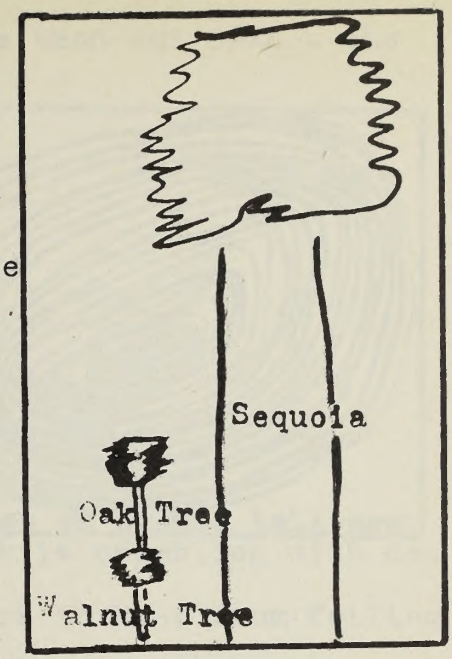

Chief Sequoia

The largest of these trees is called the General Sherman tree. It is about 280 feet high; it is 102 feet around the base of the trunk, and the bark is almost two feet thick. No other tree in the world is so tall and at the same time so large around the trunk.

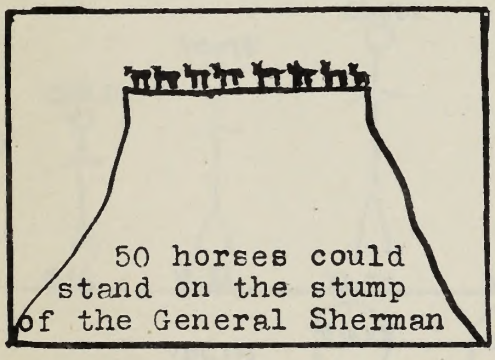
Reprinted from Stories In Trees by Mary I. Curtis, Lyons & Carnahan

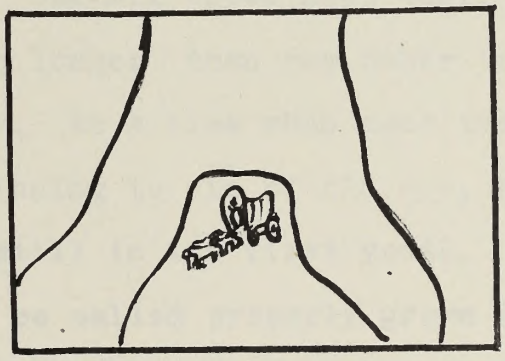


If you could put the tallest oak tree that you know on top of the tallest walnut tree that you have ever seen, the two together would not reach up to the top of the General Sherman Tree. Lofty pine trees, which grow very tall indeed, look like little saplings beside these forest giants. If the General Sherman Tree were cut off smoothly, fifty horses could easily stand upon its stump.

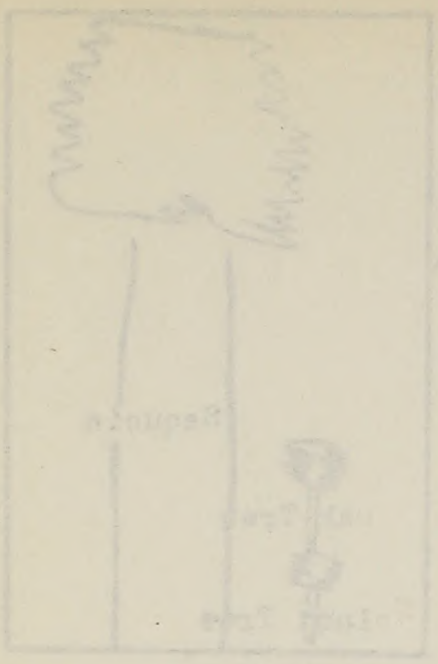


One of the Big Trees has a tunnel cut right through the trunk. The tunnel is so big that a coach and four horses can pass through it easily. Not far from this tree is a house which is nothing but the hollow log of a fallen Sequoia tree, with doors and windows cut where they are needed.





Sequoias are not only the largest trees in the world, they are the oldest too. Some of these trees that are standing today were old trees before Columbus ever discovered this land in which they live. Perhaps the General Sherman Tree was beginning to grow when Moses was a baby. At any rate, men who know how to judge the age of trees tell us that some of the Big Trees must be more than five thousand years old. We can hardly believe that anything that lived in those long ago days can be still living today, but you can count more than four thousand rings



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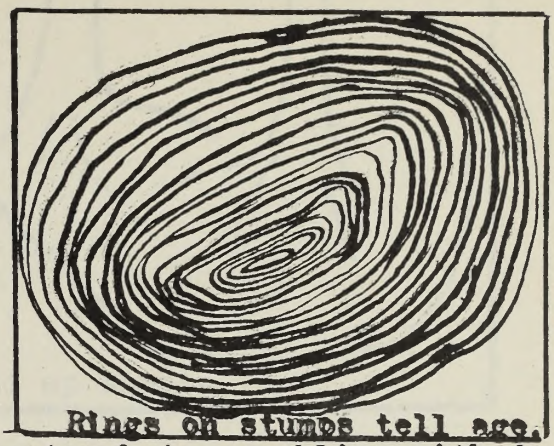
Rings on stumps tell age.

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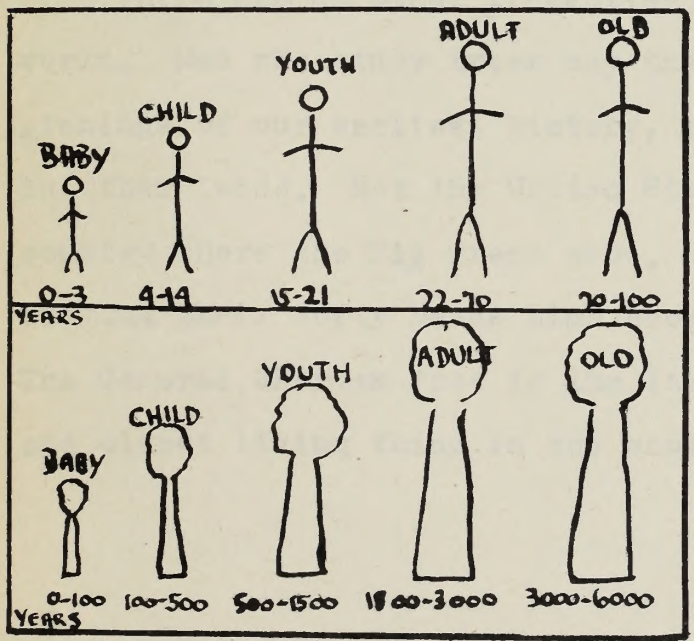

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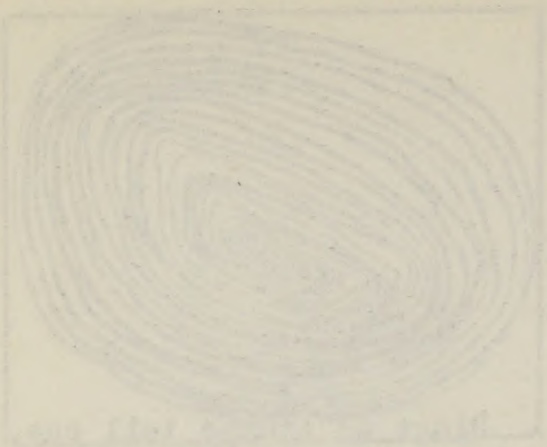

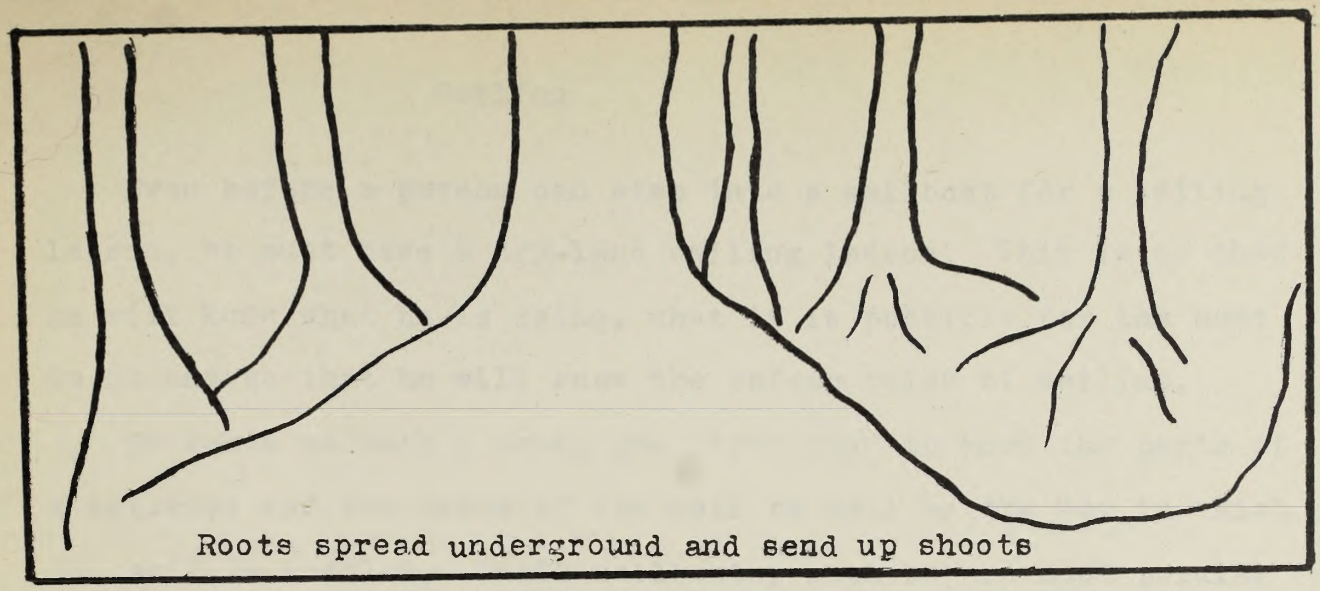

Roots spread underground and send up shoots

No blight ever seems to fall upon these wonderful trees. Full of eager, vigorous life, they stand high above all the other trees of the forest looking out over the world - the first of all the trees to see the early light of morning, and the last to bid the sun good night.

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Sailing

Even before a person can step into a sailboat for a sailing lesson, he must have a dry-land sailing lesson. This is so that he will know what he is doing, what it is possible for the boat to do and so that he will know the safety rules of sailing.

To learn to sail a boat, you first need to know the parts of a sailboat and the parts of the sail as well as the way in which the sail is handled. Small sailboats, such as are most popular with young people in small harbors, usually have only one sail or else one large sail and one smaller sail.

The forward part of a boat is called the bow while the back part of a boat is known as the stern. The main part of a boat, not including the mast and sails, is the hull. The top part of the hull is the deck. Each of these parts has various sections each having a special name, but it is not important for us to learn those in this simple lesson.

There are two main types of sailboats as far as the shape of the bottom of the boats is concerned. Most boats have a keel which extends along the center of the bottom and helps to keep the boat properly balanced. Some small light-weight boats have a center-board instead of a keel. A center-board serves the same purpose as a keel and is nothing more than a wide board, fixed so that it can be pulled up when the boat is in shallow water.

We have spoken about the main part of the boat (the hull) and about the part of the boat that is underwater (keel or center-board). Now let us learn something of the rest of the boat. The part that we will be most concerned with is the sail. The sail is made of canvas or some other fabric. It is attached to a long wooden pole called the mast which rises from the deck. The mast is near the

center of the boat, but usually toward the bow. To keep the lower part of the sail in place, it is attached to another shorter wooden pole called the boom. So the sail is held fast by two poles, the mast and the boom.

The top part of the sail is its head and the bottom edge is quite naturally called the foot of the sail. The edge of the sail which is attached to the mast is known as the luff while the leach is the outside edge of the sail. These are the four principal parts of the sail. If a boat,has more than one sail, the largest and most important is named the mainsail probably because it is the main or principal sail on the boat. The smaller sail on a boat of this kind is known as the jib.

All boats have many ropes, ropes to raise and lower the sails, ropes to control the sails when you are sailing and ropes for many other purposes. However, we do not call them ropes on board ship. Once we step off a dock and into a boat, we must learn to speak a new language, the language of the sea. And just as we call it a deck on a boat and a floor in a home, so we call ropes lines on a boat. These lines all have different names according to their uses on the boat. The lines that are used to let out or take in the sail are called sheets. For example, the line that controls the mainsail is the mainsheet. Can you imagine what name is given to the line that controls the jib? It is called the jibsheet.

We will learn the name of only one other important thing on the boat in this first dry-land sailing lesson. It is the part of the boat which serves the same purpose as the steering wheel on your car. In sailing, the boat is steered by the tiller. The tiller looks like a stick of polished wood and is attached to the stern.

Now let us see how well you have learned your first lesson about boats and sailing.

FORM B

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SCHOOL:

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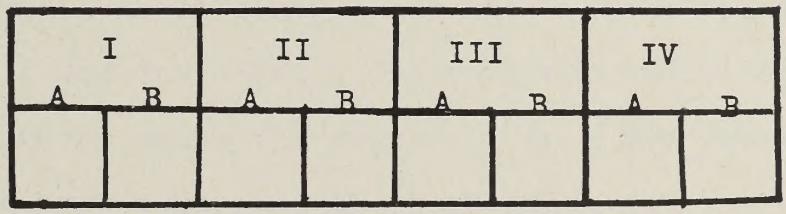


The Panama Canal

You have learned how Columbus sailed westward across the Atlantic Ocean in search of a short route to the Spice Islands of the East. Columbus died without knowing that he had discovered two large continents and that these continents barred his short route to the East. The great discoverer sailed alomg the Isthmus of Panama looking for a passage way. Other explorers kept up the search for two hundred years before they learned that the New World blocked their westward route all the way from a frozen ocean in the north to another frozen ocean in the south. You have read how Balboa crossed the Isthmus of Panama and discovered the Pacific Ocean and heard stories of vast wealth in the lands farther south.

This wealth was soon discovered. Then there was a great deal of travel across the isthmus to get the gold and silver of Peru and ship it to Spain. Only thirty years after the discovery of America, Spanish began to talk about digging a canal across the isthmus to connect the two oceans. They talked about it for three hundred years and by that time they had lost most of their New World empire.

Nothing was done until about sixty uears ago, when a French company made an attempt to dig the canal. The work was badly managed and there was much sickness among the workers. In a gew years the company could raise no more money and the work stopped.

The United States had been deeply interested in a canal across the Isthmus for many years. A canal would shorten immensely the sailing distance between our east and west coasts. The value of a canal was clearly shown in the war with Spain when one of our battleships had to steam all the way around South America to go from the Pacific Ocean to the Atlantic.

Reprinted from Our Country by Beebe, Hanna, McClure, Laidlaw.

Theodore Roosevelt was President of the United States when the work was started. Our government paid the French company forty million dollars for their rights and for the work they had done. This payment did not give the United States all the rights it needed. At this time Panama was one of the states of the Republic of Colombia in South America.

Panama feared that the canal would be dug in another location. She had fought fifty-three revolutions in fifty-three years and she decided it was a good time to have another. This time she was protected by the United States and so Colombia could do nothing.

Panama became an independent republic. Two weeks later she sold the Canal Zone to the United States for ten million dollars. The United States also promised to pay Panama $250,000 each year. The Canal Zone is a strip of land ten miles wide reaching from ocean to ocean.

Before the United States could start the real work on the canal, the Canal Zone had to be cleaned up and made free from yellow fever and malaria. This worl was in charge of William C. Gorgas who had learned in Cuba how to control hot climate diseases. The streets of the cities were paved. Sewers were dug and a supply of pure water was piped into the cities. The Canal Zone was one of the worst yellow fever regions of the world. We had learned in Cuba that yellow fever is spread by a certain kind of mosquito. To fight this insect the government of the Canal Zone screened all the houses, drained the swamps, and sprayed oil on the pools of water where mosquitoes laid their eggs. All this was a heavy task but it made the Canal Zone the most healthful place in the hot regions of the world.

After trying several other engineers, the government placed the work of digging the canal in charge of George W. Goethals of the United States Army.

The Atlantic end of the Canal Zone has more than twelve feet of rain a year. This amount of rain makes the streams full and swift.

They tumble down the hills and rush on to the ocean. The American engineers built an immense dam across one of the rivers and in this way made a large body of water which is now a huge lake. This lake makes up twenty-three miles of the canal but it is eighty-five feet above the level of the oceans. Boats are lifted up to the level of the lake by means of three large locks near each end of the canal. The canal has been called a "bridge of water."

Digging the Culebra Cut was the hardest job of all. Here it was necessary to dig through nine miles of almost solid rock. This great ditch is 375 feet deep and 300 feet wide at the bottom. At the top the cut is more than half a mile wide.

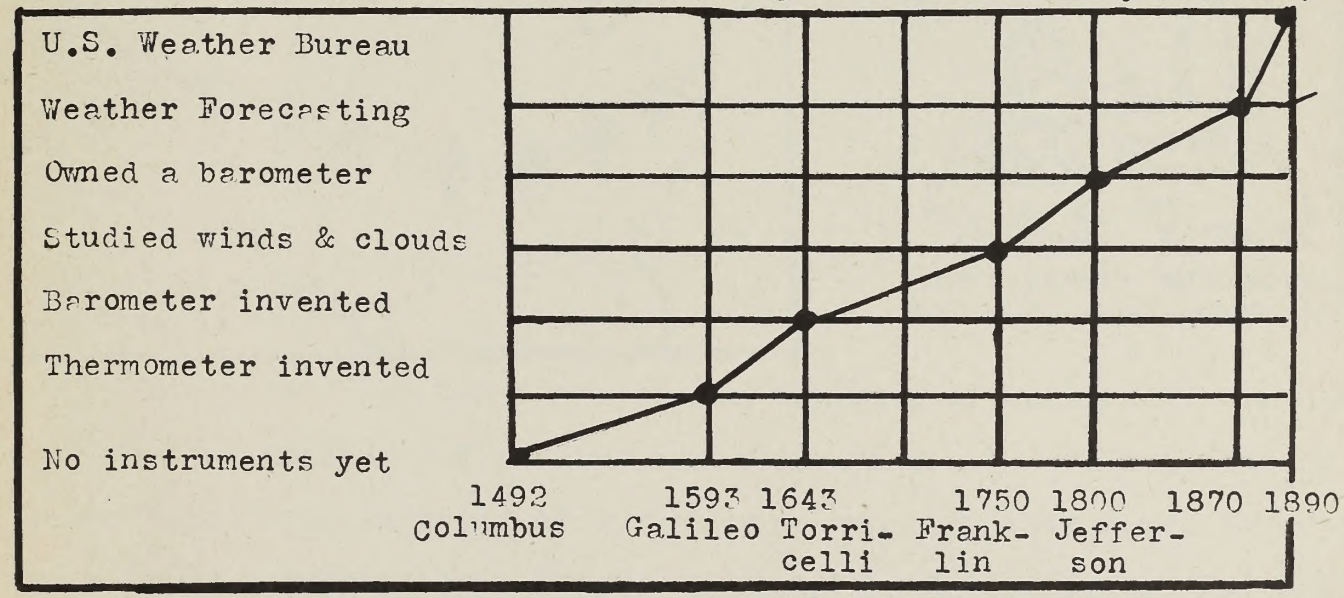
The Panama Canal was a machine age undertaking. Large steam shovels loaded the rock and earth into railroad cars. The long trains were pulled away by locomotives and the rock and dirt taken off by machinery. The great work was finished in the year when the First World War began. It was now clearer than ever before that the United States was becoming a world power with world-wide interests to protect.

The Panama Canal is now one of the busiest trade routes in the world. In peace times it is used on equal terms by the ships of all nations. The canal has shortened the sailing distance between our eastern and western coasts by ten thousand miles. It has brought the seaports of western South America seven thousand miles nearer to our eastern seaports than they were before. In time of war we can move our fighting ships from one ocean to the other in a few days.

The Weatherman and His Work

For hundreds of years men have watched the sky and wondered about tomorrow's weather. But the men of long ago knew little about the great ocean of air which is all around us. They had no way to tell what the weather would be. They had no way to send news of the weather quickly from place to place.

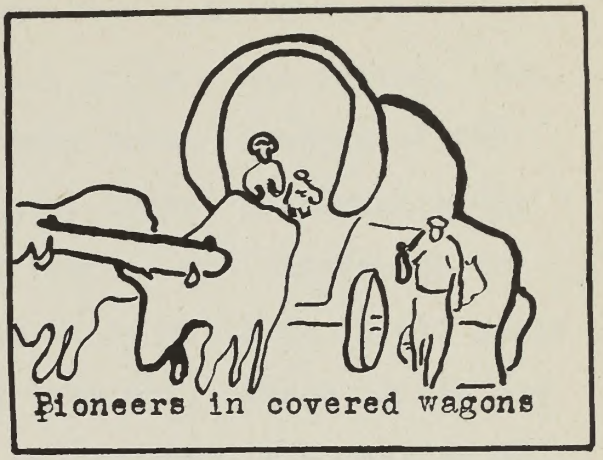
When Columbus discovered America, no way had been invented to find out how cold or how hot the weather was. The first thermometer was not invented until about one hundred years later. In 1593, Galileo of Italy made a crude instrument to mark the temperature. In 1643, Torricelli, his assistant and secretary, invented the barometer, or weather-glass, which marks the coming of fair or stormy weather.

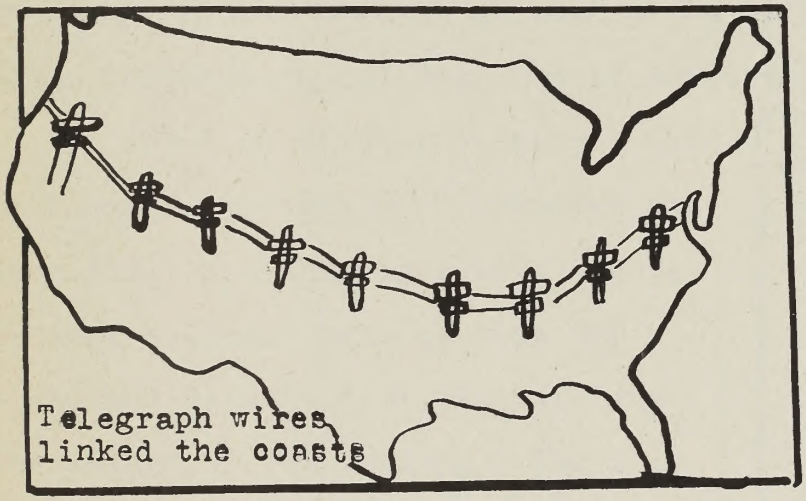


Many great men have been interested in the weather. Benjamin Franklin looked up at the sky just as you and I do and wondered if those dark clouds meant rain. In fact, he did more than wonder about those clouds. Franklin studied the winds and the weather. Thomas Jefferson was interested in the weather, too. He actually owned a barometer, and in those days there were only two in all the Colonies.

Reprinted from Weather by A. Eleanor Thomas, Unit Study Book No. 551.

Real weather forecasting in our country did not begin until the year 1870. By that time, the American Colonies had become the United States of America. The early pioneers had crossed the continent in their covered wagons and settled the West. Trains puffed and snorted over the plains and through the mountains. Telegraph wires linked the Pacific Coast and the Atlantic Coast. News could now be carried quickly from place to place.


Pioneers in covered wagons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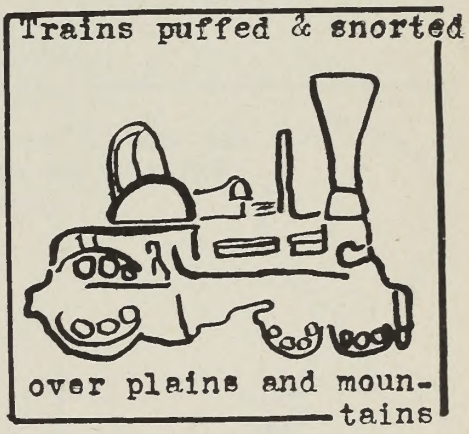
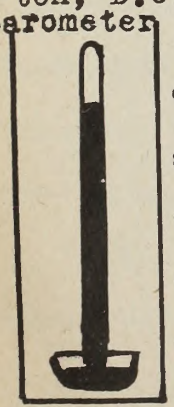
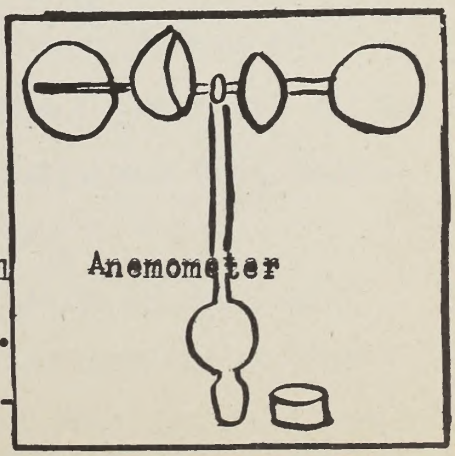

Trains puffed & snorted over plains and mountains

Congress gave the Secretary of War the duty of setting up weather stations and sending out weather reports. He was to collect news of the weather from all parts of our country and from this news, forecast the weather. Twenty years later, in 1890, the United States Weather Bureau was set up as part of the Department of Agriculture in Washington, D.C.

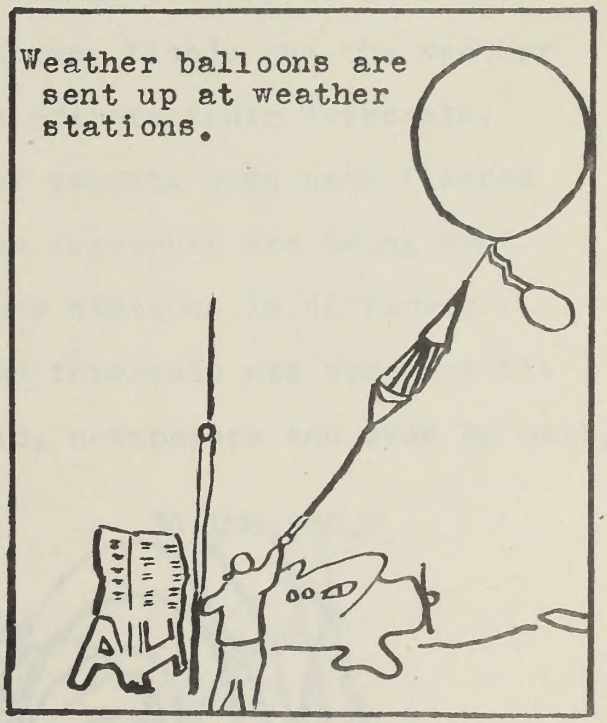

Barometer

Every morning and every evening at eight o'clock, weathermen at observing stations study the clouds and look at their instruments. The barometers tell them the pressure or weight of the air. The thermometers tell them the tempera-


Anemometer

ture of the air. The anemometer tells them the force and speed or velocity of the wind, and the weather vane tells them which way the wind is blowing. The hygrometer tells them how much moisture is in the air. Special gauges show how much snow or rain has fallen. Sunshine recorders, barographs and thermographs trace a record of the changes in the weather. Every morning, too, these weathermen study the height of the clouds, or the ceiling limits, and figure out the the dew points. At the same time, pilots at 26 airports in all parts of our country hop into their planes and take off. These pilots are going up to study the weather from high in the sky. The weather instruments in the cockpit of each plane will tell them the air pressure, temperature and humidity at different heights.

At about 60 weather stations, men fill small balloons with hydrogen and send them into the upper air. These weather balloons help measure the speed and direction of the wind and the height of the ceiling. The balloons are sent up at least four times within every 24 hours and oftener if the weather is very stormy or a bit unusual.

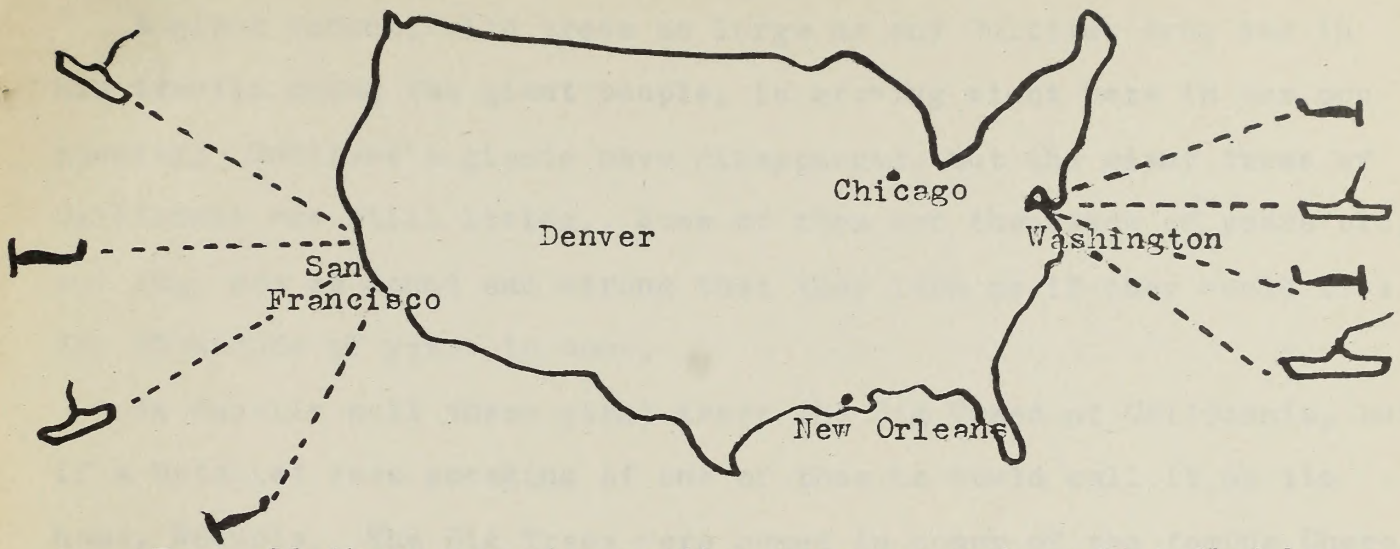


Weather balloons are sent up at weather stations.

News of the weather is sent from the weather stations to the big United States Weather Bureau in Washington, D.C. The telegraph wires buzz and hum. The radio clicks busily. Weather stations in Alaska, Canada, Hawaii, the West Indies, the Canal Zone, and Mexico are sending in reports.

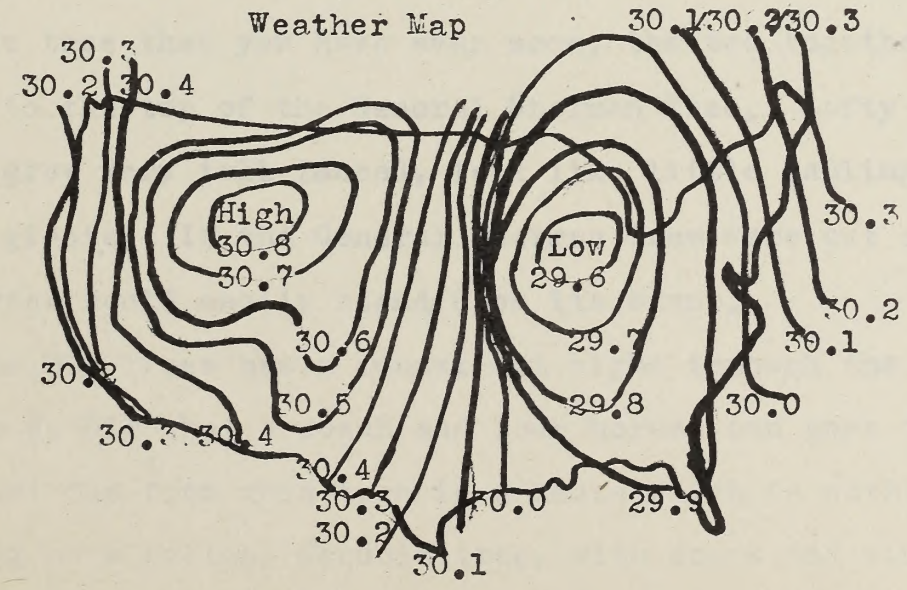
The pilots of airplanes and the captains of ships at sea flash their weather reports to Washington. More weather news comes from other countries across the Atlantic and across the Pacific, from the Azores, Iceland, Greenland and the Faroe Islands.

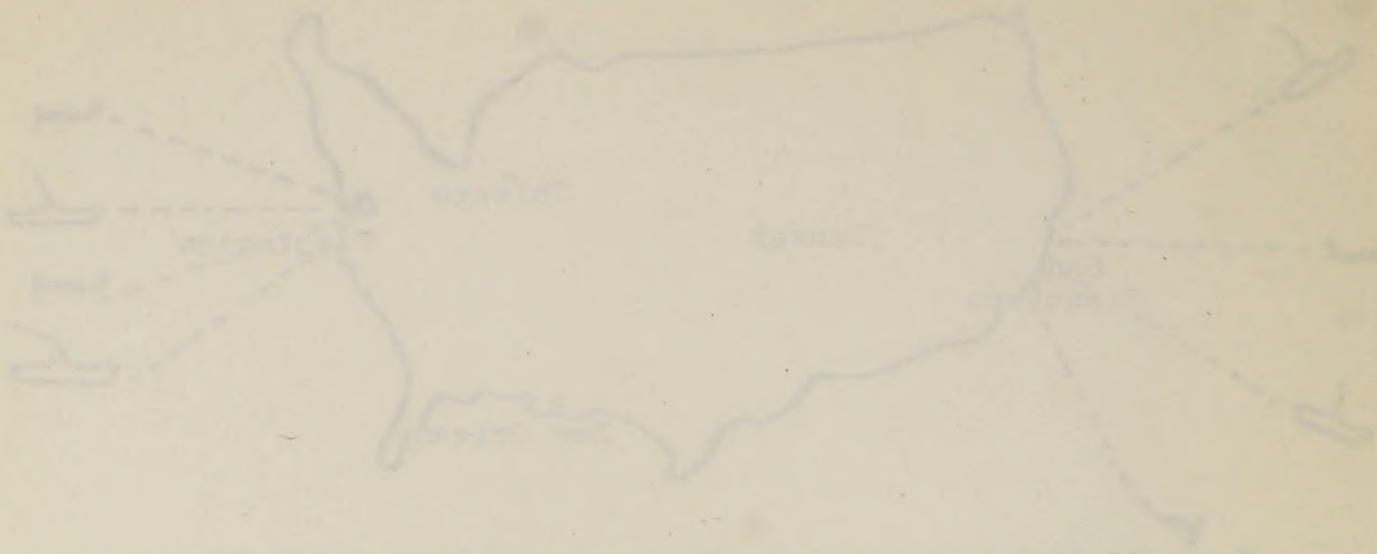
Weather Reports from Planes and Ships



From all these reports, weather maps are made and studied by weather experts in Washington, D.C., Chicago, New Orleans, Denver and San Francisco. They learn about coming frosts, cold waves, blizzards, hot spells, hurricanes, storms, floods and the weather in general. Then the weather experts prepare their forecasts.

Within two hours after the weather reports have been flashed from faraway corners of the world, the forecasts are being sent out by telegraph to nearly two thousand stations in different parts of our country. From there, the forecasts are spread still further by telegraph, telephone, radio, newspapers and even by mail.





A Giant Forest

A giant forest, with trees as large as any Gulliver ever saw in his travels among the giant people, is growing right here in our own country. Gulliver's giants have disappeared, but the giant trees of California are still living. Some of them are thousands of years old, but they are so sound and strong that they look as if they would live for thousands of years to come.

We usually call these giant trees the Big Trees of California, but if a botanist were speaking of one of them he would call it by its name, Sequoia. The Big Trees were named in honor of the famous Cherokee Indian Chief, Sequoia, who was the wisest man of his tribe and a very great man among the Indians, because he invented an alphabet for the language of his people so that they could learn to read and write, instead of making signs and pictures as they had always done before.

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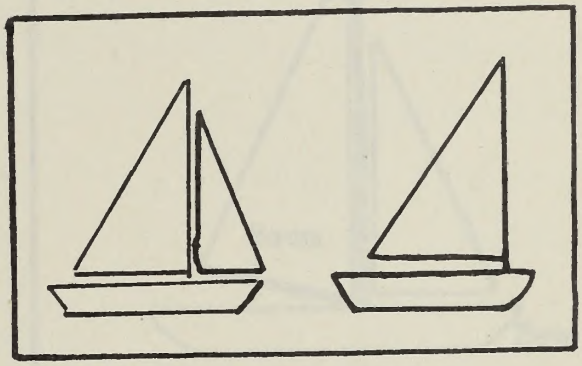
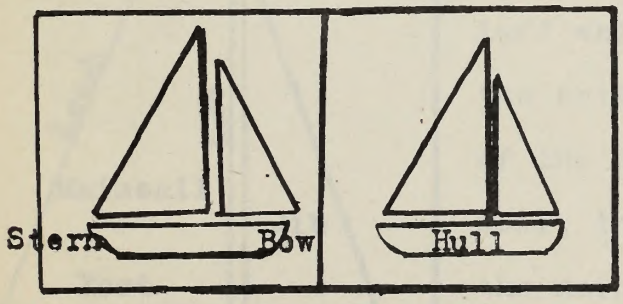
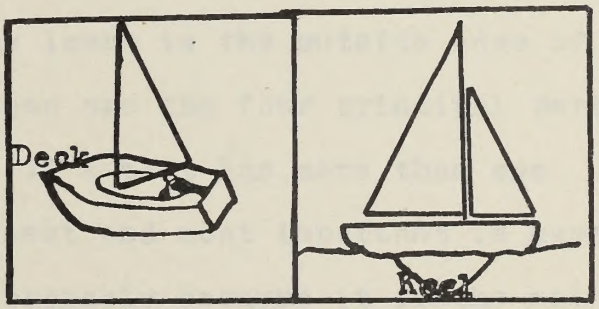


To learn to sail a boat, you first need to know the parts of a sailboat and the parts of the sail as well as the way in which the sail is handled. Small sailboats, such as are most popular with young people in small harbors, usually have only one sail or else one large sail and one smaller sail.

The forward part of a boat is called the bow while the back part of a boat is known as the stern. The main part of a boat, not including the mast and sails, is the hull. The top part of the hull is the deck. Each of these parts has various sections each having a special name, but it is not important for us to learn those in this simple lesson.

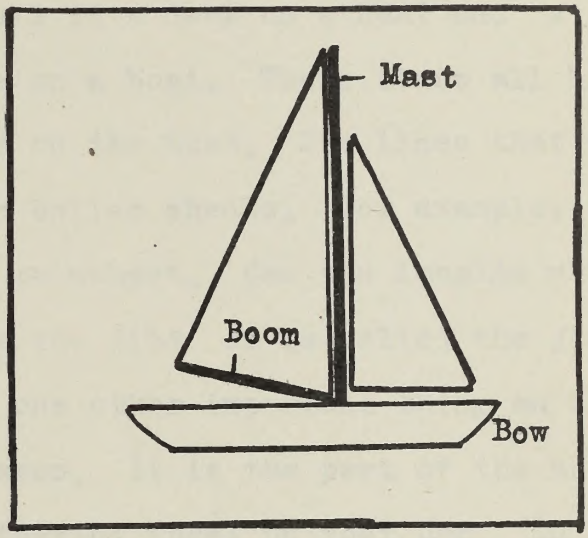


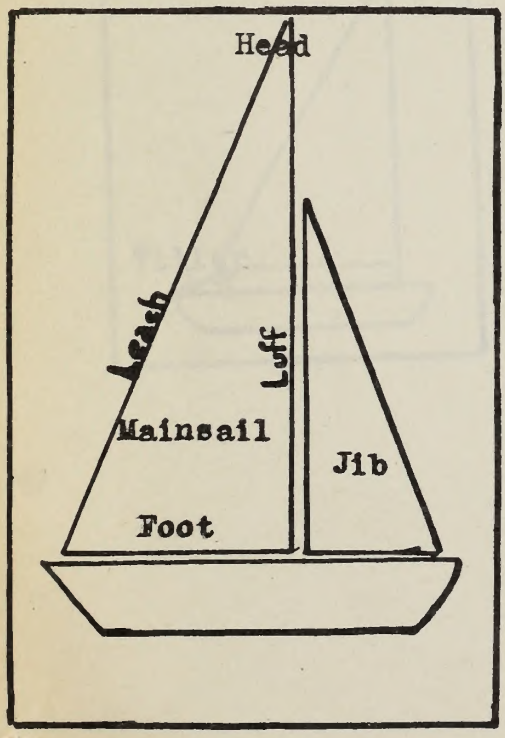


There are two main types of sailboats as far as the shape of the bottom of the boats is concerned. Most boats have a keel which extends along the center of the bottom and helps to keep the boat properly balanced. Some small light-weight boats have a center-board instead of a keel. A center-board serves the same purpose as a keel and is

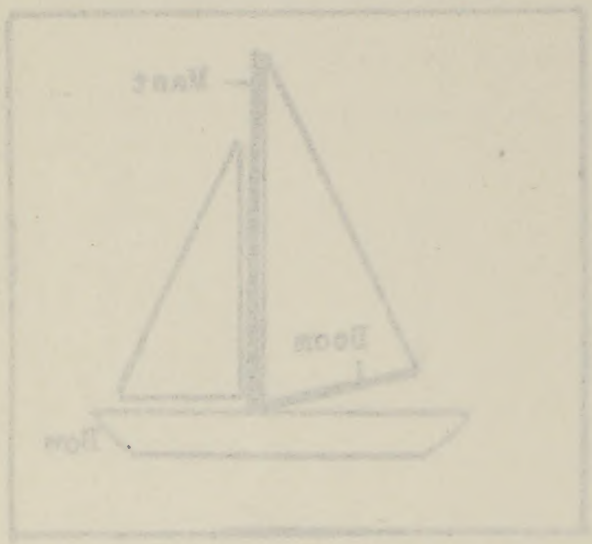
nothing more than a wide board, fixed so that it can be pulled up when the boat is in shallow water.

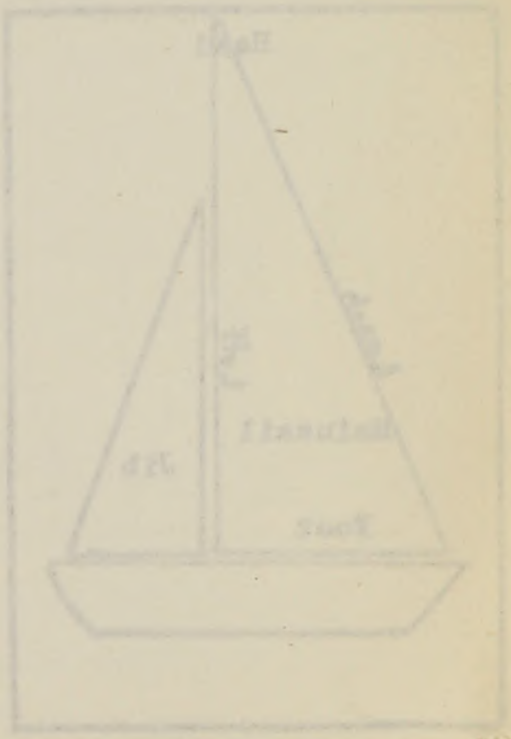
We have spoken about the main part of the boat (the hull) and about the part of the boat that is underwater (keel or center-board). Now let us learn something of the rest of the boat. The part that we will be most concerned with is the sail. The sail is made of canvas or some other fabric. It is attached to a long wooden pole called the mast which rises from the deck. The mast is near the center of the boat, but usually toward the bow. To keep the lower part of the sail in place, it is attached to another shorter wooden pole called the boom. So the sail is held fast by two poles, the mast and the boom.



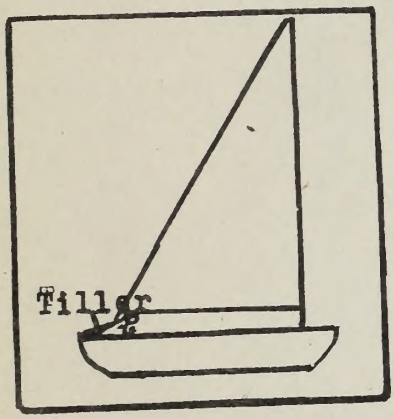


The top part of the sail is its head and the bottom edge is quite naturally called the foot of the sail. Theedge of the sail which is attached to the mast is known as the luff while the leach is the outside edge of the sail. These are the four principal parts of the sail. If a boat has more than one sail, the largest and most important is named the mainsail probably because it is the main or principal sail on the boat. The smaller sail on a boat of this kind is known as the jib.


Mast
Boom
Bow


Mast
Mainsail
Jib
Boat

All boats have many ropes, ropes to raise and lower the sails, ropes to control the sails when you are sailing and ropes for many other purposes. However, we do not call them ropes on board ship. Once we step off a dock and into a boat, we must learn to speak a new language, the language of the sea. And just as we call it a deck on a boat and a floor in a home, so we call ropes lines on a boat. These lines all have different names according to their uses on the boat. The lines that are used to let out or take in the sail are called sheets. For example, the line that controls the mainsail is the mainsheet. Can you imagine what name is given to the line that controls the jib? It is called the jib-sheet. We will learn the name of only one other important thing on the boat in this first dry-land sailing lesson. It is the part of the boat which serves the same purpose as the steering wheel on your car. In sailing, the boat is steered by the tiller. The tiller looks like a stick of polished wood and is attached to the stern.



Now let us see how well you have learned your first lesson about boats and sailing.

Directions

These directions are to be read to pupils before starting their reading.

We are going to read two stories this morning. One story has pictures and one story hasn't any pictures.

Be sure and study each picture carefully as you read your story for the picture will help you answer the questions.

We want to find out whether pictures help you or not.

Directions

FOR TEACHERS

Allow pupils to read two stories at one sitting.

Booklets to be distributed to the pupils in alternation, one child receiving Form A of the booklet, the next child Form B etc. in this manner until each child has a booklet.

No Time Limit.

Tell children to fill in Form letter also write his name, grade, and date of test given on the back of each test.

After a child has read story one have him close his booklet and pass out to him Test 1. After he has passed in Test 1 allow him to read his next story. When he has read this story collect the booklet and give him Test 11. The same procedure is carried out the next day when he reads the next two stories.

Keep all booklets of Form A together and all booklets of Form B. together. The same with the tests.

Make a list of pupils taking the test with the following information.

Name of Pupil	Date of Birth	M. A.	C. A.	I. Q.	Grade

Form1-----

Story 1

Panama Canal

Circle the correct word or words in each sentence to make the statement correct.

Examples:

A. This story is about the -----.
Panama Canal Suez Canal Erie Canal Blackstone Canal

B. The canal connects the Atlantic Ocean and the ----- Ocean.
Arctic Indian Pacific Anarctic

1. The United States was deeply interested in a ----- across the isthmus.
bridge chart route canal

2. The Canal Zone is a strip of land ----- miles wide.
twenty ten twelve thirteen

3. The Atlantic end of the Canal Zone has in summer more than -----feet of rain.
10 7 13 15

4. Boats are lifted up to the level of the lake by means of ----- large locks.
2 3 4 5

5. The canal is -----feet above the level of the ocean.
60 65 85 95

6. The hardest job of all was the digging through ----- miles of almost solid rocks.
3 5 7 9

7. The huge cut made in the solid rock was called the -----.
Canal Cut Cycle Cut Culebra Cut Cook Cut

8. The greatest ditch is ----- feet deep.
85 375 750 300

9. The method in the construction of the Canal proved that we were living in a ----- Age.
Electrical Machine Mechanical Gas

10. Huge -----were used in the construction of this mighty project.
bulldozers steam shovels electric girders large shovels

Form:----- Story 11

The Weatherman and His Work

Circle the word or words that makes each statement true.

Examples:

A. This story is about -----.
weather winter wind water

B. Weather stations were set up by the ---- in Washington, D. C.
Chamber of Commerce President United States Government
State Department

1. Columbus had ----- instruments to measure how cold or hot weather was.
many few no three

2. -----tells which way the wind is blowing.
Barometer Balloons Weather Vanes Thermometer

3. The first thermometer was invented by Galileo of Italy in ----.
1643 1492 1593 1800

4. The United States Weather Bureau was established in -----.
1643 1750 1870 1890

5. The ----- tells the pressure or weight of the air.
barometer thermometer anemometer hygrometer

6. The ---- tells the force and speed or velocity of the wind.
barometer anemometer thermometer hygrometer

7. Weather ----- are sent up at least four times within every 24 hours from weather stations to help measure the speed and direction of the wind and height of the ceiling.
kites balloons balls vanes

8. In the U.S. there are nearly ----- weather stations which are helpful for the predictions of the weather.
500 1000 1500 2000

9. From all reports sent in by weather stations to Washington, D.C. weather ----- are made and studied.
signals maps stories telegraphs

10. After the experts at Washington, D.C. study carefully their findings they prepare their -----.
broadcasts forecasts telephones telegraphs

Form:-----

Story 111

A-Giant Forest

Circle the correct word or words in each sentence to make The statement true.

Examples:

A. The story is about -----trees.
small baby big giant

B. The ----- has the honor of raising these huge trees.
United States United Kingdom United Nations United County

1. The Giant trees are still living in the State of -----.
Utah New Mexico California Massachusetts

2. The rings on the stumps tell the ----- of the tree.
height width age growth

3. The Big Trees were named in honor of the famous Cherokee, Indian Chief -----.
Squanto Squatum Sequoia Sitting Bull

4. If the General Sherman Tree were cut off smoothly -----horses could easily stand upon its stump.
25 55 75 100

5. The Sequoia is not properly grown-up before it is ----- years old.
500 1000 1500 2500

6. The Giant Trees are not considered old until it has lived---years or more.
1000 2000 3000 5000

7. If you put the tallest oak and the highest walnut tree you ever saw together they would not reach up to the ----- of the General Sherman Tree.
leaves top middle branches

8. One of the Big Trees has a tunnel cut right through the trunk. It is so big that -----can pass through it easily.
four coaches and three horses one coach and four horses
three horses and a coach five horses and coaches

9. The roots of the Big Tree stretches out under the ground for -----feet or more around each tree.
300 275 200 1500

10. Young Sequoia Trees are like children growing in a family around the ----- tree.
old parent home center

Form:----- Story IV

Sailing

Draw a circle around the word or words that make the following statement true.

Examples:

A. This story tells about -----.
shipping sailihg rowing fishing

B. Small -----, usually have only one sail or else one large sail and one smaller sail.
tug-boats motor-boats sail-boats speed-boats

1. ----- sailing lesson is important before you learn to sail a boat.
Dry land Dock land Sea going Practice exercise

2. The top part of the hull is called the -----.
stren deck bow keel

3. The forward part of a boat is called the -----.
stern deck bow keel

4. The back part of the boat is known as the -----.
bow stern deck hull

5. The main part of a boat not including the mast and sails is the -----.
bow stern deck hull

6. The ----- extends along the center of the bottom and helps to keep the boat properly balanced.
mast boom bow keel

7. The sail is attached to a long wooden pole called the ----- which rises from the deck.
mast boom bow leach

8. To keep the lower part of the sail in place, it is attached to a wooden pole called the -----.
mast boom bow leach

9. The top part of the -----is called its head and the bottom edge is called the foot.
mast boom sail bow

10. The part of the boat which serves the same prupose as the steering wheel on a car is called the -----.
tiller jib sheet leach mainsail

Retest

Form ----- Panama Canal Story 1

Circle the correct word or words in each sentence to make the statement true.

Examples:

A. The title of this story is -----.
Panama Canal Suez Canal Erie Canal Blackstone Canal

B. The Atlantic Ocean and the ----- Ocean are connected by this canal.
Arctic Indian Pacific Anarctic

1. The ----- across the isthmus deeply concerned the United States.
bridge chart route canal

2. A strip of land ----- miles long is called the Panama Canal.
twenty ten twelve thirteen

3. The summer rain fall on the Atlantic end of the Canal Zone is more than ----- feet a year.
10 7 12 15

4. -----large locks lift the boats up to the level of the lake.
2 3 4 5

5. The canal is raised -----feet above the level of the oceans.
60 65 85 95

6. The digging through of -----miles of solid rock was the hardest job of all.
3 5 7 9

7. When the digging was complete the huge cut made in the solid rock was called -----.
Canal Cut Cycle Cut Culebra Cut Cook Cut

8. ----- feet deep was the depth of the greatest ditch.
85 375 750 300

9. The construction of this large undertaking proved we were living in a ----- Age.
Electrical Machine Mechanical Gas

10. In the construction of this mighty project huge ---- were used.
bull dozers steam shovels electric girders large shovels

Retest

Forms:=====

Story 11

The Weatherman and His Work

Circle the word or words that make each statement true.
Examples:

A. ===== is mostly talked about in this story.
Weather Winter Wind Water

B. In Washington, D.C. the =====set up Weather Stations.
Chamber of Commerce President U.S. Government State Depart.

1. To measure how cold or hot the weather was Columbus had ===== instruments.
many few no three

2. By looking at the ===== we can tell which way the wind is blowing.
barometer balloons weather vanes thermometer

3. Galileo of Italy invented the first thermometer in =====.
1643 1700 1593 1800

4. In ===== the U.S. Weather Bureau was established.
1643 1700 1870 1890

5. The pressure or weight of air is measured by the =====.
barometer thermometer anemometer hygrometer

6. The force and speed or velocity of the wind is measured by the =====.
barometer anemometer thermometer hygrometer

7. The weather stations send up weather ===== to determine speed and wind direction and height of ceiling.
kites balloons balls vanes

8. In the U.S. there are nearly =====weather stations which are helpful for their predictions.
500 1000 1500 2000

9. At Washington, D.C. weather =====are made and studied from all reports sent in by Weather Stations.
signals maps stories telegraphs

10. ===== are determined by experts at Washington, D.C. after they have carefully studied the findings sent into them by the weather stations.
Broadcasts Forecasts Telephones Telegraphs

Retest

Form: ----- Story 111

A Giant Forest

Circle the correct word or words in each sentence to make the statement true.

Examples:

A. We learn much in this story about the ----- trees.
Small baby big giant

B. The country that has the honor of raising these huge trees is the -----.
United States United Kingdom United Nations United County

1. The State of ----- has the honor of raising these huge trees.
Utah New Mexico California Massachusetts

2. One can tell the ----- of a tree by the rings on the stumps.
height width age growth

3. The famous Cherokee, Indian Chief ----- had the honor of having the Big Trees named after him.
Squanto Squatum Sequoia Sitting Bull

4. You can easily stand ----- horses on the stump of General Sherman Tree if it were cut off smoothly.
25 50 75 100

5. When the Sequoia Tree is considered grown-up it must be at least ----- years old.
500 1000 1500 2500

6. The Big Trees are not old until they have lived ----- years or more.
1000 2000 3000 5000

7. Putting the highest walnut and the tallest oak tree together you would not reach up to the ----- of the General Sherman Tree.
leaves top middle branches

8. A tunnel cut through the Big Tree is so big that ----- can pass through it easily.
four coaches and three horses one coach and four horses
three horses and a coach five horses and coaches

9. Under the ground of the Big Trees the roots stretch out for -----feet or more around each tree.
300 275 200 1500

10. The young Sequoia Trees are compared to children growing in a family around the ----- tree.
old parent home center

Retest

Form:------

Story IV

Sailing

Draw a circle around the word or words that make the following statements true.

Examples+

A. ----- is the title of this story.
shipping sailing rowing fishing

B. Usually small ----- have only one sail or else one large sail and one smaller sail.
tug-boats motor-boats sail-boats speed-boats

1. Before you learn to sail a boat you should take -----sailing lessons.
dry-land dock-land sea-going practice-exercises

2. The ----- is the top part of the hull.
stern deck bow decker

3. The ----- is called the forward part of a boat.
bow stern hull deck

4. The -----is known as the back part of a boat.
bow stern deck hull

5. The ----- is the main part of a boat not including the mast and sail.
bow stern deck hull

6. Extended along the center of the bottom of the boat to Help keep it properly balanced is the -----.
bow stern hull keel

7. The long wooden pole rising from the deck which the sail is attached is the -----.
mast boom bow leach

8. The ----- has a wooden pole attached to the lower part of the sail to keep it in place.
mast boom bow leach

9. The ----- has the top part called its head and the bottom edge is called the foot.
mast boom sail bow

10. The steering wheel on a car serves the same purpose as the ----- on a boat.
tiller jib sheet leach mainsail

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